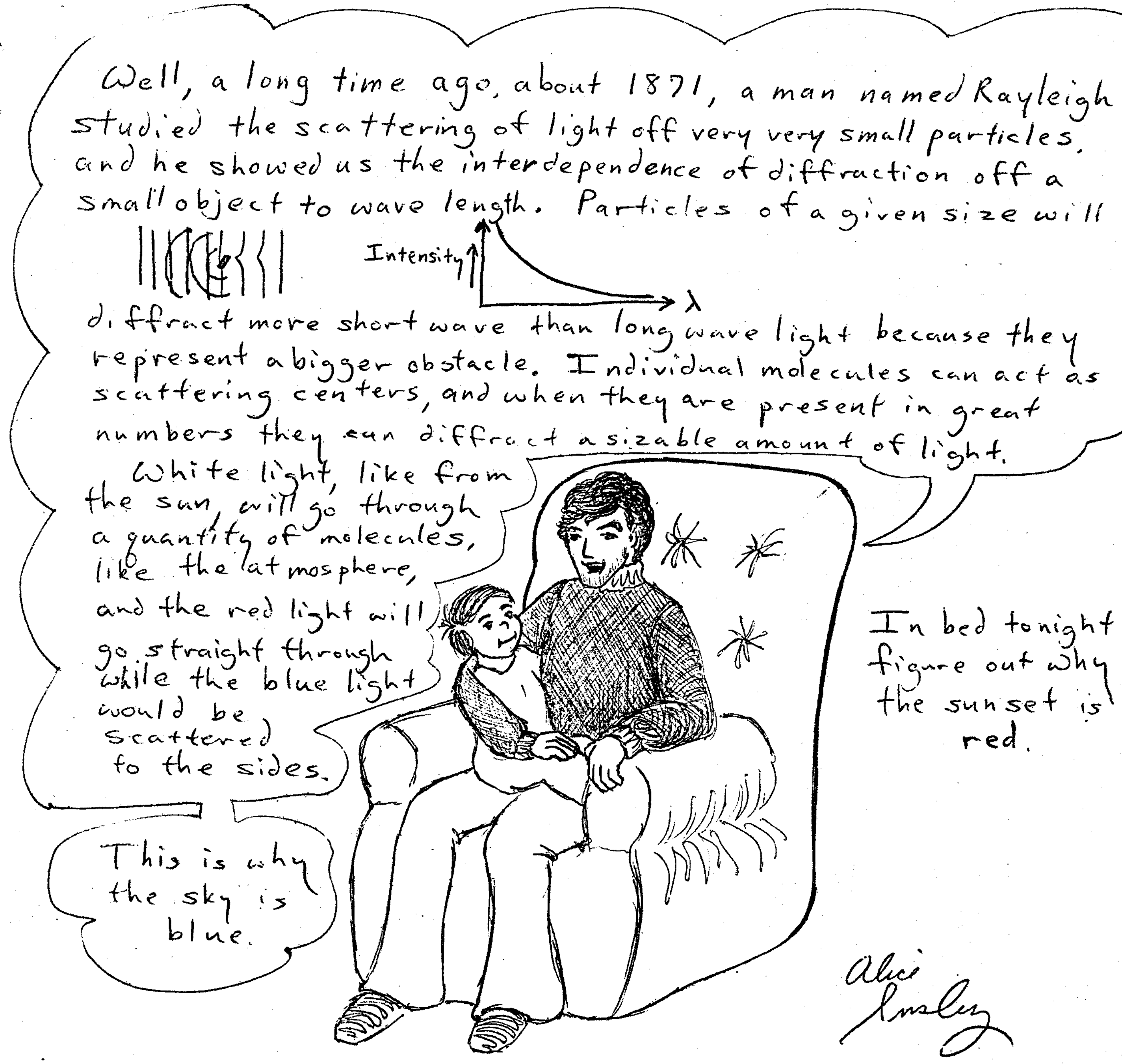
QS 8&9

1980 Winter Solstice Double Issue


Well, a long time ago, about 1871, a man named Rayleigh studied the scattering of light off very very small particles. and he showed us the interdependence of diffraction off a small object to wave length. Particles of a given size will
Intensity
λ
diffract more short wave than long wave light because they represent a bigger obstacle. Individual molecules can act as scattering centers, and when they are present in great numbers they can diffract a sizable amount of light.
White light, like from the sun, will go through a quantity of molecules, like the atmosphere, and the red light will go straight through while the blue light would be scattered to the sides.
This is why the sky is blue.
In bed tonight figure out why the sunset is red.
Alice Insley

UNCLE GREG AND HIS PHENOMENAL BEDTIME STORIES

TONIGHT: WHY THE SKY IS BLUE

THE Quintessential Singularity 8&9

21 December 1980 for APA-TECH 10

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NOT Vernon Valley Ski Resort: the House at Wits' End, Rt. 94, Carlton Village, R.R. Box 390,
Hamburg, N.J. 07419 (201-827-6111: yes, the former number of...)

Home of the Eight-meter Pigeon Roosts: Western Union Glenwood Earth Station, Vernon Crossing Road,
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* * *

The dust clears at last from the madness of home chores and holiday preparations. I am now ready to plunge into this double issue, as I threatened.

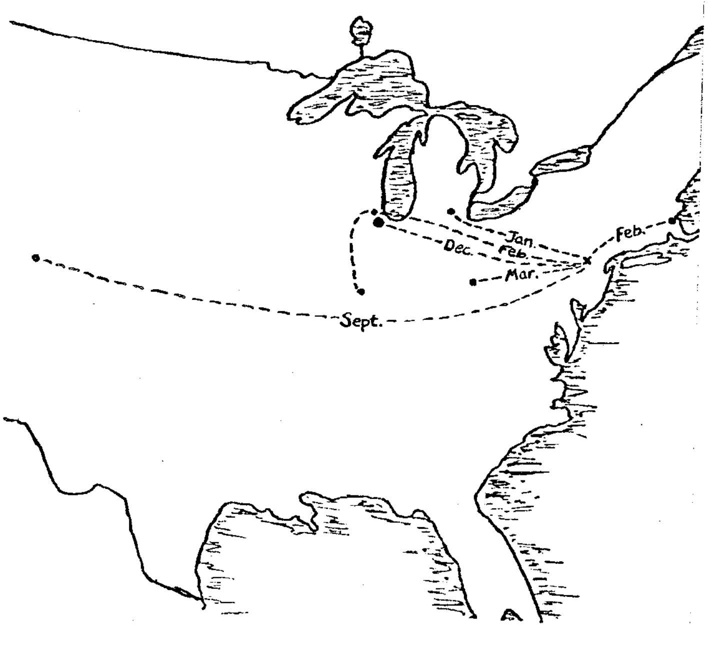
The last four months have been largely routine. I just wound up what turned out to be my last month on night shift as a Controller. At the actual time that I am typing this (10 PM, December 31st), I have just recently learned that I am now in my last month as a Controller. On January 19, I will begin working here during normal human hours in Orbital Dynamics. I am not sure exactly what my responsibilities will be, but I suspect some large part of them will involve preparing our own orbital calculation programs.

Orbital Dynamics School last month was fun; it reminded me how much I miss some aspects of Academia. In one week, we dealt with basic Keplerian motion, perturbational effects, stationkeeping maneuvers, attitude dynamics, and orbit determination. One of the most surprising things I learned, after having carefully studied all the classical 19th-Century methods of determining an orbit from positional measurements, is that practically everyone in the field today just integrates the acceleration equation numerically by computer. With a sufficient body of measurements, one can also extract from the data the aspherical mass distribution of the Earth, the gravitational effects of the Sun, Moon, Jupiter, etc., the strength of solar radiation pressure, and other perturbing influences. All of this is in preparation for improving upon the programs Hughes gave us back in 1974 (which descend from programs written in 1964, when core was core...) when we get our redundant in-house PDP 11-70s around May. Right now we run our programs through a line to WU's facility in Mahwah, which is a nuisance when everyone there goes home after hours and the system crashes. We also note from the oscillations in the telemetry signal strengths of our satellites that all three are precessing to some extent (one cannot consume propellant in a perfectly symmetrical manner). We would like to work out how to rebalance the internal mass without waiting around for Hughes to tell us how.

Christmas was quite pleasant, particularly since I was able to have someone else stay here to watch over things (being a Thursday, it was really part of my work week). I couldn't ask for that again, so here I am on New Year's Eve and the rest of the week...

Since I will be upstate most of the time henceforth, I will need an apartment I can actually live in. The Village Management is watching for a suitable opening for me, so the only change in address apparent to the remote observer will be a new Rural Route box number by April 1st. This will give me a couple months to settle again before becoming Guest GTB for APA-TECH #13 (so Renee informs me).

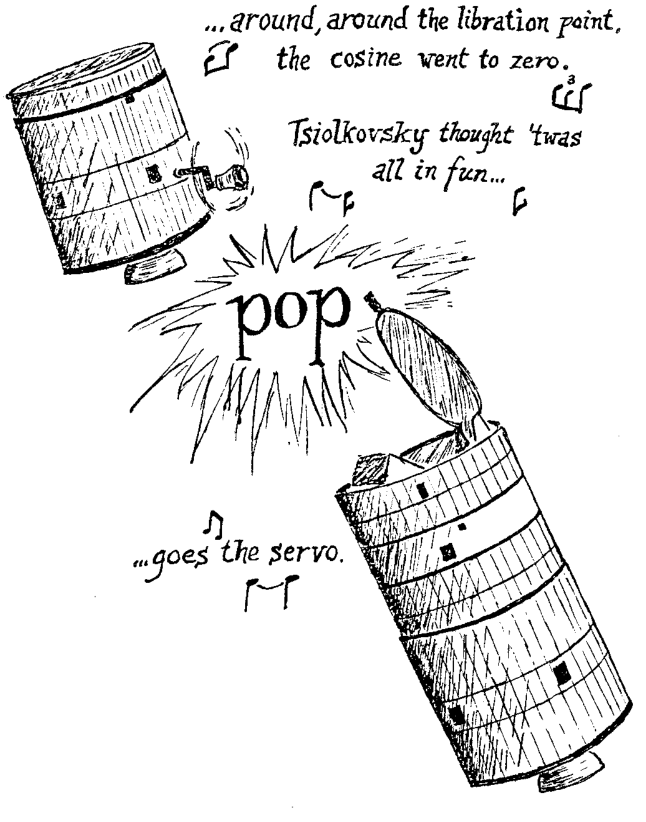
I've made what is probably my final list of conventions that I expect to attend next year. I'll be at Confusion for the first time this January: it seems to be cheaper to fly there from Newark than from Champaign. I'll be driving to Boskone 18 the following month; I think the last one I went to was number 12. Is anyone else out there looking for an excuse to revisit Boston? The following week, I'll be flying to Chicago to see what all this brouhaha is in Evanston. I am taking a week's vacation after that to make what may be my final visit to Champaign. I have already reserved a double at the Evanston Holiday Inn and am once again recruiting boarders; interested applicants are requested to give me a yell sometime soon. I will need a lift from the airport that Friday and a ride down to Champaign on Sunday. May I once again impose myself upon the celebrated hospitality of the Midwest? Just two weeks after I leave Chambana, I spin around and land in Columbus, by which time you should be heartily sick of my visits. Denver finally acknowledged my existence; I am presently deciding which $50+/day room I'd like to walk to the convention from; once the city has decided what they'll give me, I'll be looking for tenants. Anyone else planning to go breathe some thin air? And, of course, in December, everyone goes to Windycon... With travel expenses as costly as they are, I am postponing my plans to purchase a computer for a while. I want to put away some money this year.



Just after Thanksgiving, I acquired a genuine 13-minute Maltman Avenue Not-a-Frisbee. The Wizard was actually bowled over by this and sent me all sorts of supplementary literature. I'll bring it along for PRIVATE (at his request) viewing in February.

Having suffered enough befuddlement as an electronic illiterate, I am taking night courses at a couple of nearby county colleges next semester in electronics and also in geology and modern art. WU will pay me back for the engineering course; I doubt that I can convince them that an understanding of terminal morraines or of the Cubists will enhance my "career development".

Hughes sent us a cute Christmas present: it was a die-cut sheet of slot-and-tab pieces that assemble into a model of the HS-376, copies of which will become Westars IV and V. The HS-376 enjoys the distinction of being the world's first "pop-top" satellite.


...around, around the libration point,
the cosine went to zero.
Tsiolkovsky thought 'twas
all in fun...
pop
...goes the servo.

I left as an exercise last time to prove that:

$$\sum_{i=1}^{N} i^3 = \left(\sum_{i=1}^{N} i\right)^2 .$$

Keith's proof is substantially similar to the one I was going to give, so I won't reiterate it. What I consider the sneakiest method in mathematics is proof by induction. The principle of mathematical induction states that a theorem is true if it is true for N = 1 and also, assuming that it is true for some arbitrary integer N, that it is true for N+1. That is to say, what's sauce for the goose, and what's sauce for N+1 geese, is sauce for any integral number of geese. It sounds hokey as anything, but it is a fundamental postulate in the structure of mathematics (and if *you* don't like it, you can just go use some *other* mathematics!).

* * *

Permit me to lapse into a trance and dimly recall conventions long gone...

NOREASCON II

Strangely, what I recall most about this convention was some truly fine dining (Steve's Ice Cream on Wednesday night, Mama Maria's Thursday, Locke-Ober Friday, Ginza Saturday, and Legal Seafoods Sunday) in good company. I enjoyed myself immensely and succeeded in putting a crustacean on the backs of a few Midwestern folk.

As for the convention itself, I went to one whole talk, in which, unfortunately, Marvin Minsky had little new to say. I saw two movies for the first time: *Time After Time* and *The Life of Brian*. Both had a number of delightful bits in them, but I did not feel entirely satisfied. The first was very well acted and had a very serious social point to make. I just thought there were too many time-travellers' loose ends left around. As my erstwhile roommate, Guy "Where's the River?" Consolmagno is fond of saying, "Heinlein did it forty years ago and he did it better." Monty Python, as always, comes up with some truly inspired ideas, but often runs into problems stringing them together. For blooper fans, did anyone spot the gentleman in 20th-Century dress strolling around in the background in one shot of the Crucifixion Sequence? I saw most of the amateur shorts, but the hit of the show was the chartreuse-clad fellow who needs no further introduction. I never did get to any of the video rooms.

Otherwise, my time was spent showing off MIT and the Center of the Universe and raiding various bookstores. I thought the convention was very well run (I understand NESFA wore out a lot of whips). Keeping the ice-cream stand open all night almost compensated for the beverage stores being closed due to local blue laws. Support Boston in 1989!

WINDYCON 7

You can't beat the Hyatt Regency at 67% off! Someone pulled off a veritable *coup*. Now if they'd just discount the parking and food...

The hotel is convenient to all sorts of shopping by day and to practically nothing at night. I would suggest that the Chicon committee compile a *very* good list of nearby eateries by 1982 or there is going to be SCREAMING.

I think my attendance of activities consisted of getting wiped out in the Trivia Bowl semifinals, despite the sterling efforts of my teammates. The highlight was seeing the Kittons depose their arch-rivals, the Worldcon champs.

Who needed formal activities, though, with the Marshall Fields LEGO exhibit and some nice big bookstores nearby? Dining at Azuma was fine, too. Organization is becoming a severe problem, however. It has become impossible to go out with *everyone* one would like to and some people are feeling slighted. Is there a humane solution?

Some time was also spent by assorted GT persons (who shall remain anonymous, pending a grand jury hearing) in plotting and/or executing assorted deviltry in and around the convention site. CO_2-falls, light shows on the Wrigley Building, raft races in the lobby fountain, and animated skylines were allegedly discussed. (In a moment, the results of that trial...)

The one meal worth the money at the Hyatt is the Sunday Brunch for $11. I fear my fellow ChUSFAns and I emulated pigs. So what?

TRIVIAL GRUMBLINGS

I'm afraid I have to say that the Windycon Trivia Bowl was only so-so this year; they've done far better in the past. This one pointed up all the evils of the "College Bowl" format, to my mind. It would have helped also if the M.C. had been able to remember all the rules and to pronounce the names...

Whilst I harp upon this, John Nine has offered to work on the Chicon Trivia Bowl and I am trying to re-assemble as much of the Whatcon writing team as possible. I'd also like to work on the Windycon 8 trivia. Who should we talk to?

* * *

BRIEF NOTES:

For you feathered-serpent-god fans in the audience, minor planet 1915, known as Quetzalcoatl, will be passing within eight million miles of Earth on March 2nd, on its way out to the asteroid belt from a perihelion just beyond our own orbit. This is the closest approach it has made in 75 years or will make until the mid-2000s. Unfortunately, its maximum visual brightness will be 13th magnitude, requiring a good clear night and at least an 8" telescope.

WANTED: L.E.O. SANITATION ENGINEERS -- An article by Vladimir Chobotov in the September 1980 Aeronautics and Astronautics discusses the risk of collision between functioning satellites, especially those in low orbit, and the rest of the 4100 objects presently tracked by NORAD. The author also assesses the problem in 15 years, when the number of objects could become 30,000. "The probability of collision by 1995 for a 50-m.-radius spacecraft in a 1000-day, circular-orbit, low-altitude (500 - 1500 km.) mission could be on the order of 50%. This would clearly be unacceptable."

I found the Starbow paper. That is to say, a paper in the Journal of the British Interplanetary Society (vol. 18, pp. 273-7, 1961) by E. Sänger, entitled "Some Optical and Kinematical Effects in Interstellar Astronautics", appears to be the one that set people off on starbows. The physics all looks fine, but Sänger does state the following assumption:

> For simplicity's sake, we may assume that the stars ... as seen from the space vehicle when at rest, are all of a medium yellow color, of perhaps λ_o = 5900 A.

If one makes this assumption, one gets the expected graduated Doppler shift, with the consequent starbow and forward "blind spot". Of course, as I'm sure the author was aware, stars are not monochromatic light sources and must be treated at least as blackbody radiators of various temperatures, as has been mentioned before. Someone else didn't read the fine print...

In the January Scientific American, Douglas Hofstadter of G E B fame noted that he will be alternating with Martin Gardner in the Mathematical Games section (anagrammatically titled "Metamagical Themas"). Gardner will be retiring after December, having performed inestimable services in that column for 25 years. Next year, the good Doctor Hofstadter will be appearing there regularly.

Now that Cosmos has completed its run on PBS (it will be re-run in the fall), they are dangling another morsel before us. The History of Space Flight will commence on February 10th (timed to coincide with the final Shuttle tests?). I'll have to get some more tape...

November 4th and 5th were quite firmly overcast out this way, although some of the pre-dawn skies have been quite pretty since then. With weather like this, is it any wonder I'm a theoretician?

* * *

REVIEWS:

Now that I've finished just about everything Niven has published, except Lucifer's Hammer, I will loosely rank them (for what it's worth) by literary merit.

I: The Mote in God's Eye, Ringworld
II: World of Ptaavs, Protector, Ringworld Engineers, A World Out of Time, The Flying Sorcerers
III: Patchwork Girl, Gift From Earth, The Magic Goes Away

In the first class, I have put two novels that I consider modern "classics" and could stand up with most of what contemporary literature has produced (were science fiction more "respectable"). I put in the middle class stories which I still think are quite good, but are not quite as "powerful". The last rank includes works I was not satisfied with for various reasons. In the latest of these, Patchwork Girl, I cannot say that I found the basis of the mystery especially convincing.

Among Niven's anthologies, I recommend just about all of the stories in Tales of Known Space, Neutron Star, A Hole in Space, Flight of the Horse, and The Long Arm of Gil Hamilton. In All The Myriad Ways, I thought the title story and "Inconstant Moon" were best. Convergent Series incorporates the out-of-print anthology, Shape of Space, and many of his most recent short stories. I think of the title story as perhaps the most characteristically Nivenesque of his short tales; I also felt "One Face" and "The Meddler" to be the best in this collection.

As is probably clear from the above, I am not as fond of his work after 1975 for the most part. It is remarkable to me, nonetheless, that he has produced so many fine stories in the interval of only 15 years.

I've only received Wizard in the last month through the SFBC and have yet to read it. As for the rest of John Varley's works, I would say that he is one of the great new short story writers we have. One of his principal themes seems to be the effects biological engineering would have on human society and our world-view (a process of alteration accelerated by the obliteration of Earth-bound culture). The best stories in Persistence of Vision are the title story, "Air Raid" (has anyone else heard a rumor that there are plans to make a movie out of it?), "The Phantom of Kansas", "Overdrawn at the Memory Bank" (much in the spirit of Phillip K. Dick), and "Gotta Sing, Gotta Dance". My favorites in The Barbie Murders are the title story, "Equinoctial", and "The Funhouse Effect" (yet another variation of the "...then he woke up" story). I don't feel that Varley has developed an equal command of the novel form, to judge from The Ophiuchi Hotline and Titan. The latter seems to be Varley's "Ringworld" and I am curious to see where he will lead us in his proposed trilogy.

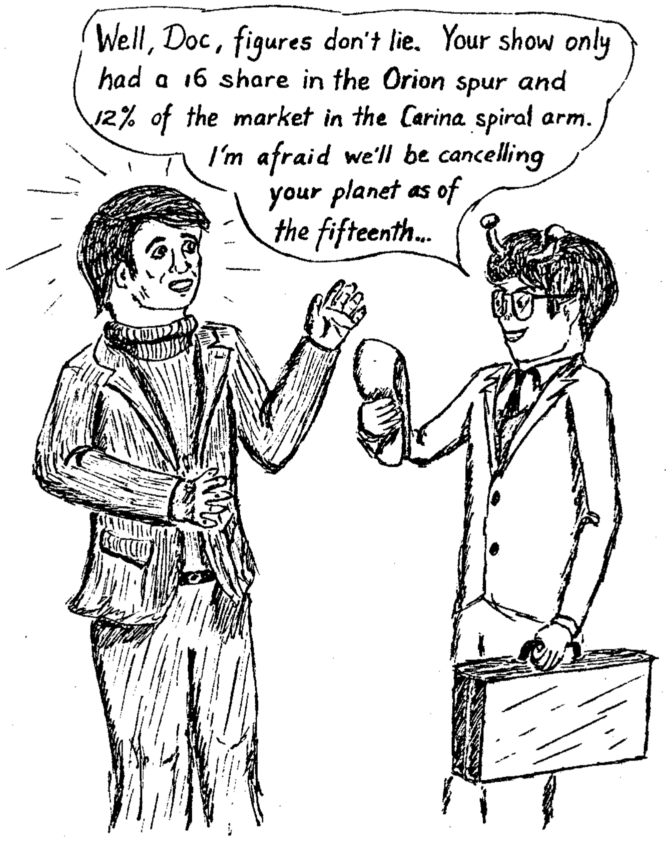
I didn't like any of Pohl's last three novels. Gateway was the best of them, although I wasn't much taken with the hokey psychiatric aspects of the book. JEM doesn't get in and really develop the alien cultures that Pohl introduces, so one doesn't really get a feeling for what the humans are interfering with. Beyond the Blue Event Horizon takes two of its most serious plot complications and casually brushes them aside. The author does show a considerable skill in his last two novels for creating genuinely unlikeable characters. The annoying part is that, since almost all of them are greedy and cynical, there is little contrast; there are no real "heroes".

I am rather puzzled by something, having just finished Clarke's last three novels, Rendezvous with Rama, Imperial Earth, and The Fountains of Paradise. They all embody his characteristic visionary thinking, his talent for metaphor, and his feeling of "technological mysticism" (the grandest feats of engineers can rival the most glorious works of Nature: God as Most Supreme Engineer). As a work of literature, however, Imperial Earth manages to merge this with strong characterization and "human" situations. So how come the other two won the Hugos?

I am adding to my bibliography on life elsewhere in the Universe the recent book by the Good Doctor Asimov, Extraterrestrial Civilizations. It appears to offer the most thorough analysis of the question among the spate of recent books on this subject (although I cannot claim to have read them all). If you are interested in an up-to-date study of the problem at an introductory level, this is the place to start.

My sole objection is a technical one: I feel his evaluation to be highly optimistic. Asimov sets the number of planets on which technological civilizations have developed at 390 million and the number of extant civilizations at 530,000. For my own reasons, which I may elaborate upon some other time, I put these numbers closer to 14,000 and about 35, respectively. It is far easier then to deal with the question, "Why don't we hear from them?".

Cosmos has finished its awaited run. I think it's important for the critics to understand that it is not an astronomy course, but Sagan's personal ramble through the implications of our modern world view. As such, I felt that some of the segments meandered a good bit without providing a strong sense of where the argument was headed or why it had to pass through some of the territory that it did. Sagan does show a tendency to preach sometimes and some of the presentations were rather self-indulgent. My chief concern is over the matter of whom the intended audience is. The average PBS viewer is sufficiently well-educated to be aware of some of these ideas. Anyone who has read some or all of Sagan's books has heard most of this before. I thought it was a well-produced series, but I have my doubts that the world audience it will eventually reach will find the message all that compelling.


Well, Doc, figures don't lie. Your show only had a 16 share in the Orion spur and 12% of the market in the Carina spiral arm. I'm afraid we'll be cancelling your planet as of the fifteenth...

You never know if
anyone else is watching...

On a more positive note, James Burke's Connections was concurrently re-run and I recently read the book version. Burke is a very entertaining speaker and his intricate history of technology and human events is presented in a highly anecdotal style. Much of this carries over to his book, though not with quite as much humor. This is a very enjoyable series, which does not try to make the pretense of being Civilization or The Ascent of Man.

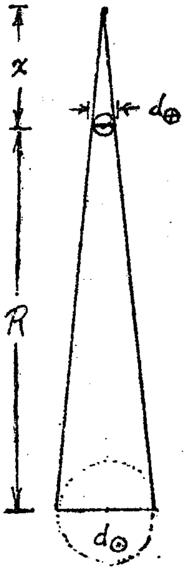
The second series of The Hitch-hikers' Guide to the Galaxy again has many delightful moments in it, but I sensed a great deal of strain in the effort to make this idea run for another six episodes. I am curious to see how Adams will handle the third series which now seems likely. Perhaps I'd have enjoyed it more if it weren't for the pain in the diodes all down my left side...

* * *

"Well, you haven't had much nice to say so far. I suppose now you're going to do some astronomical derivations..." Wouldn't be an issue of QS without 'em!

One matter which must be considered in the design of a solar-powered satellite in geosynchronous equatorial orbit is that it most necessarily spend some time in the Earth's shadow. This plainly occurs when the Earth's shadow falls upon or quite close to the plane of the Equator, which implies that the Sun must also be quite near the plane of the Equator. Consequently, for an interval of roughly six weeks centered upon each of the two equinoxes, the satellite's usual source of power is eclipsed and it must make use of its on-board storage batteries.

How long does this condition persist? What we'll look at is the longest possible interval such an eclipse can last. Rather than set up the problem for the exact geometry which occurs during the "eclipse seasons", we'll simply examine the two extreme cases and use the results to bracket the actual answer. (This turns out to determine the answer fairly precisely.)



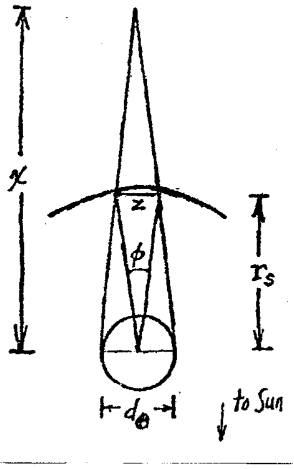
The Earth's umbra, or "dark shadow", within which the Sun is totally eclipsed, is precisely defined by the pair of similar triangles shown at left. From this geometry, one can write the relation:

$$\frac{x}{d_\oplus} = \frac{R+x}{d_\odot} ,$$

where x is the length of the umbra, R is the Earth-Sun distance, $d_\oplus$ is the Earth's diameter, and $d_\odot$ is the Sun's diameter. Rearranging this equation yields:

$$x = R\left(\frac{d_\oplus}{d_\odot - d_\oplus}\right) .$$

The diameter of the Earth is $d_\oplus = 1.276 \cdot 10^4$ km. and the diameter of the Sun is $d_\odot = 1.392 \cdot 10^6$ km. ; with an orbital semi-major axis of $149.6 \cdot 10^6$ km. and an orbital eccentricity of 0.01672, the Earth-Sun distance at perihelion is $R_p = 147.1 \cdot 10^6$ km. and at aphelion is $R_a = 152.1 \cdot 10^6$ km. Thus, the length of the umbra is $x_p = 1.361 \cdot 10^6$ km. (845,600 mi.) when the Earth is at perihelion and is $x_a = 1.407 \cdot 10^6$ km. (874,400 mi.). The tip of the umbra is over three-and-a-half times as remote from Earth's center as the orbit of the Moon.



How long does it take a geosynchronous satellite to cross the diameter of the umbra? We need to know how great a sector of the satellite's orbit falls within the shadow. The radius of the geosynchroos orbit is determined uniquely by its orbital period of one sidereal day (the Earth's rotational period) or 86,164 seconds ; the radius, r_s, from Kepler's Third Law, is 42,160 km. ($6.6107\, r_\oplus$). The chord, z, of the orbit through the umbra is given by the relation:

$$\frac{z}{x - r_s} = \frac{d_\oplus}{x} ;$$

at perihelion, the length of this chord is $z_p = 12{,}361$ km. and at aphelion, $z_a = 12{,}374$ km.

The arc of the orbit passing through the umbra subtends an angle ϕ, determined by the equation:

$$\phi = 2\sin^{-1}\left(\frac{z/2}{r_s}\right) ;$$

we find that $\phi_p = 16\overset{\circ}{.}859$ and $\phi_a = 16\overset{\circ}{.}877$. The amount of time the satellite requires to cover this arc is given by:

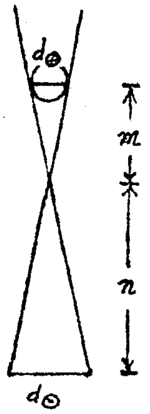
$$T = \frac{\phi}{360^\circ} \cdot 86{,}164 \text{ seconds} ;$$

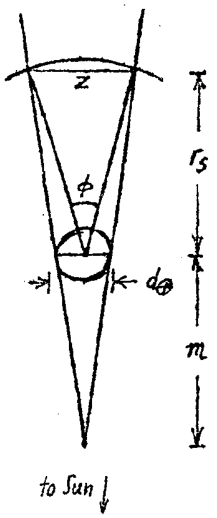
the maximum possible length of eclipse at perihelion would be $T_p = 4035.2$ sec. $= 67.25$ min. and at aphelion would be $T_a = 4039.5$ sec. $= 67.32$ min. In fact, the eclipses cannot occur at either of these points in the Earth's orbit, but the actual possible maximum eclipse interval is very narrowly delimited.

The penumbra, or "secondary shadow", within which the Sun is at least partially eclipsed, is also defined by a pair of similar triangles, such that

$$\frac{m}{d_\oplus} = \frac{n}{d_\odot} \quad \text{and} \quad m + n = R ;$$

hence, we have $n = \left(\frac{d_\odot}{d_\oplus}\right) m = 109.09\ m$ and $110.09\ m = R$, so $m_p = 1.336 \cdot 10^6$ km. and $m_a = 1.382 \cdot 10^6$ km.





The chord, z, through the penumbra is determined by a pair of similar triangles, producing the relation:

$$\frac{m}{d_\oplus} = \frac{m + r_s}{z} ;$$

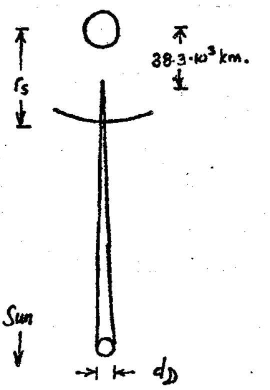
at perihelion, the length of this chord is $z_p = 13{,}158$ km. and at aphelion, $z_a = 13{,}145$ km. As before, the arc of the orbit passing through the penumbra is $\phi_p = 17\overset{\circ}{.}955$ at perihelion and $\phi_a = 17\overset{\circ}{.}937$; the amount of time the satellite requires to cover this arc would be $T_p = 4297.5$ sec $= 71.62$ min. at perihelion and $T_a = 4293.2$ sec. $= 71.55$ min. at aphelion. The actual possible maximum interval again lies between these closely-spaced limits.

If it is possible for the tip of the Moon's umbra to reach the Earth's surface, then it must surely be so that a geosynchronous satellite can be plunged into eclipse by the Moon. This would take place at a time when the Sun, Moon, satellite, and Earth are all nearly collinear, that is, at some time during the "ecliptic intervals", the periods when solar and lunar eclipses may occur.

We may determine the length of the Moon's umbra as before. The orbital semi-major axis of the Moon is $384.4 \cdot 10^3$ km. and its orbital eccentricity is 0.0549, so its distance at perigee is $363.3 \cdot 10^3$ km. and at apogee is $405.5 \cdot 10^3$ km. Its closest approach to the Sun is when it is at apogee and Earth is at perihelion, producing a Moon-Sun distance of $R_1 = 146.7 \cdot 10^6$ km. (we are necessarily speaking of the conditions at "new moon" phase); its greatest remove at new moon is $R_2 = 151.7 \cdot 10^6$ km. The diameter of the Moon is $d_☽ = 3.476 \cdot 10^3$ km. Following the reasoning used previously, the length of the Moon's umbra is given by:

$$\chi = R\left(\frac{d_☽}{d_\odot - d_☽}\right) ,$$

and so varies between the extremes of $\chi_1 = 367.2 \cdot 10^3$ km. (228,200 mi.) and $\chi_2 = 379.8 \cdot 10^3$ km. (236,000 mi.).

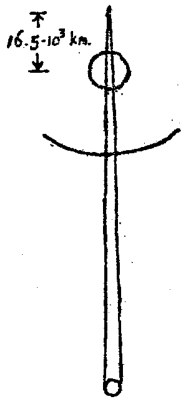


Moon at apogee, Earth at perihelion

In the first case, the umbra fails to reach the Earth's surface, falling short of Earth's center by $(405.5 - 367.2) \cdot 10^3$ km. $= 38.3 \cdot 10^3$ km. The chord, z_1, of the orbit through the umbra is given by:

$$\frac{z_1}{r_S - 38.3 \cdot 10^3 \text{km.}} = \frac{d_☽}{\chi_1} ;$$

thus, we find that $z_1 = 36.5$ km., that the arc of the orbit through the umbra is $\phi_1 = 0.^\circ0497$, and that the time needed for the satellite to traverse this arc is $T_1 = 11.9$ seconds.



Moon at perigee, Earth at aphelion

In the second case, the tip of the umbra would pass beyond the center of the Earth by a distance of $(379.8 - 363.3) \cdot 10^3$ km. $= 16.5 \cdot 10^3$ km. The chord, z_2, through the umbra is given by:

$$\frac{z_2}{r_S + 16.5 \cdot 10^3 \text{km.}} = \frac{d_☽}{\chi_2} ;$$

here, we obtain $z_2 = 537.6$ km., $\phi_2 = 0.^\circ731$, and $T_2 = 174.9$ sec. $= 2.91$ min. Once again, the exact geometry of an eclipse produced by the Moon would be intermediate to these cases (in which we have determined the longest possible eclipses).

* * *

Irrelevant insert:

Whaddaya want, good grammar, good taste, good writing, good spelling, good sense, good...?

From the Atlantic City Press Bureau: "The advent of the '80's is witness to the acceleration of the cataclsym [sic] transformation of Atlantic City from the seaside resort in despair of its deterioration into one of the world's finest entertainment-convention centers.

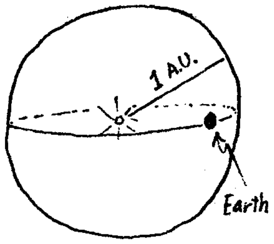
"Rivaling the destructive wrath that was visited on the fabled walls of Jericho, old walls in Atlantic City have come tumbling down and from their ruins are rising the palatial towers of plush hotel-gambling casinos to share the beachfront atmosphere with the ever present seagulls. . . .

"Like skeletal specters rising from dust, casino-hotels along the Atlantic City beachfront are pointing their steel-and-concrete fingers ever higher into the sparkling sunlit sky, each hoping to present its attractions for the fun and games of millions before too many more new years age into old years. . . ."

At Noreascon, Rolf and I had an argument about the "antimatter drive" which Dr. Forward discussed in his talk there. I expressed my doubts as to its economy for interstellar flight. There is no doubt that the most efficient method of storing energy known in present physical theory is in the form of 50% matter and 50% antimatter. I just don't think this method is right for us—yet.

Rolf has suggested that an effective strategy for interstellar travel would be uniform acceleration to a cruising speed of, say, 0.7 c followed by uniform deceleration to rest at the appropriate time. This keeps the radiation hazard caused by plowing through stationary interstellar gas from becoming unreasonable. Drag also does not become the problem that it is at close to light-speed. If the ship accelerates at a uniform 1 g. for 0.840 year (258 days) of ship's time, it will reach a velocity of 0.7 c over a distance of 0.388 light-year (24,500 AU); the ratio of payload-plus-fuel to payload for the complete one-way trip is 5.665 : 1. Let's suppose we can manage the trip with a total payload of just 10,000 metric tons; the ship will need to carry 46,650 metric tons of matter and antimatter for fuel.

Let us further imagine that an inexpensive way is found to transmute between the forms of energy, matter, and antimatter. All that is needed is an available source of energy. The Sun releases the equivalent of about 4,000,000 metric tons of mass-energy per second. The fraction of this output intercepted by the Earth is essentially the ratio of the face area of Earth to the surface area of a sphere with a radius of 1 AU, the radius of Earth's orbit. The equivalent mass-energy intercepted by the Earth each second is:



$$\frac{\pi r_{\oplus}^{2}}{4\pi R_{\oplus}^{2}} \cdot 4\cdot 10^{6}\ \text{tons/sec.} = \frac{1}{4}\cdot\left(\frac{6400\ \text{km}}{149{,}600{,}000\ \text{km}}\right)^{2}\cdot 4\cdot 10^{6}\ \text{tons/sec.}$$
$$= 1.8\cdot 10^{-3}\ \text{tons/sec.}$$
$$= 1\ \text{ton}/550\ \text{seconds} = 57{,}800\ \text{tons/year}$$

If the Earth used all of the sunlight available to it to launch such missions, it could afford to send one ship every 295 days.

A Ringworld with a radius of 1 A.U. and a thickness of one million miles would be able to collect a mass-energy equivalent of:

$$\frac{2\pi R_{\oplus} h}{4\pi R_{\oplus}^{2}} \cdot 4\cdot 10^{6}\ \text{tons/sec.} = \frac{1}{2}\cdot\left(\frac{1{,}000{,}000\ \text{mi.}}{92{,}900{,}000\ \text{mi.}}\right)\cdot 4\cdot 10^{6}\ \text{tons/sec.}$$
$$= 21{,}500\ \text{tons/sec.}$$

Such a "world" could afford to send one of the aforementioned missions, using all of its collected sunlight, once every 2.2 seconds.

A Dyson sphere collects all of its home star's light; one placed about the Sun would enable us to send up to $(4{,}000{,}000/46{,}650) \approx 86$ ships per second or roughly one mission every 12 milliseconds. Plainly, the antimatter drive is for Type II civilizations, those which can harness the energy of entire stars.

* * *

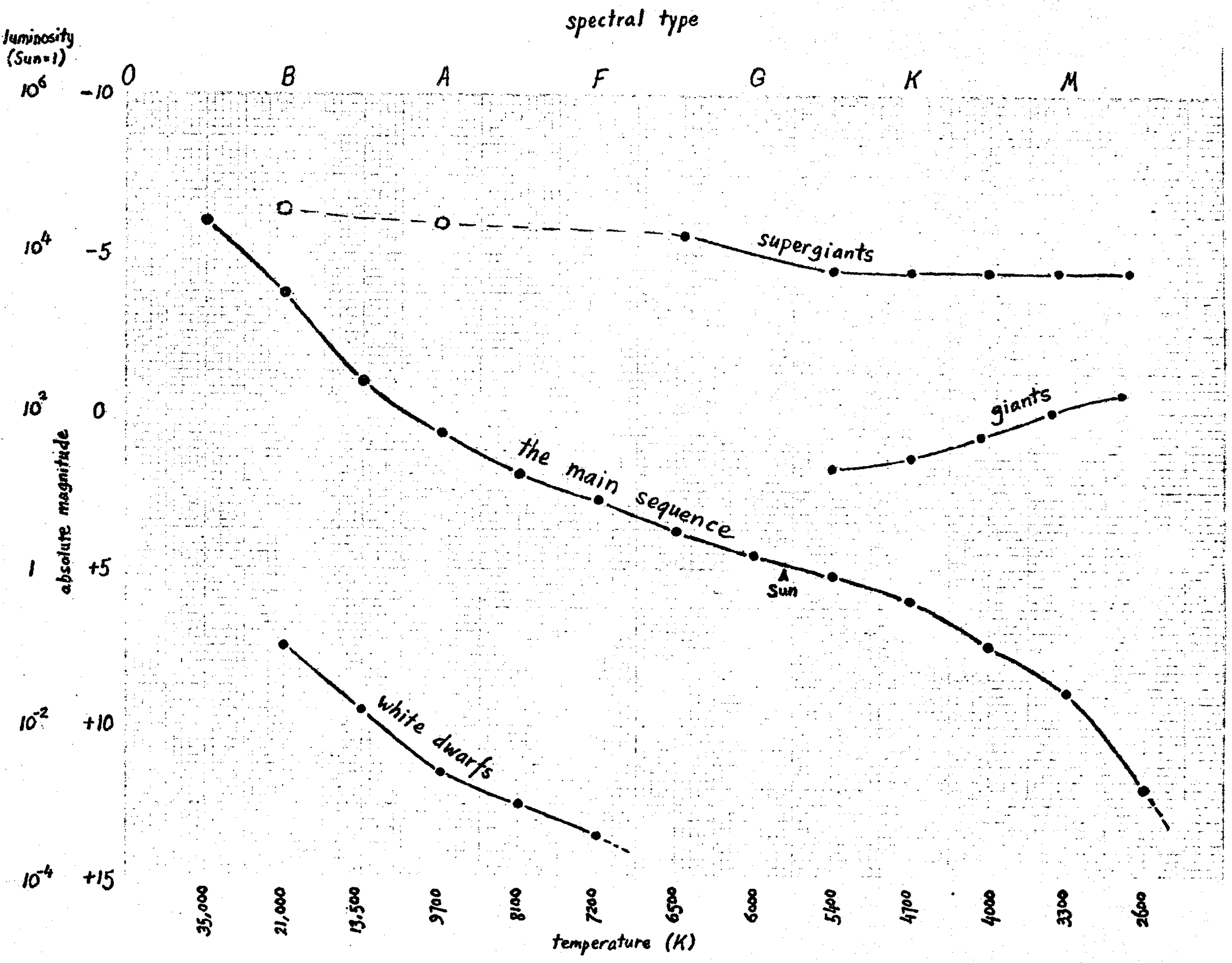
The Hertzsprung-Russell diagram is a graph which classifies stars according to surface temperature and intrinsic brightness (or luminosity). Virtually all stars fall into one of the four regions indicated; the position of the Sun is marked. I have discussed previously the effect of the Doppler shift on the appearance of stars. I have been using the formulas derived by McKinley and Doherty in their article in the American Journal of Physics. For a given Doppler factor, D, the apparent surface temperature becomes $T' = DT$ and the apparent magnitude becomes:

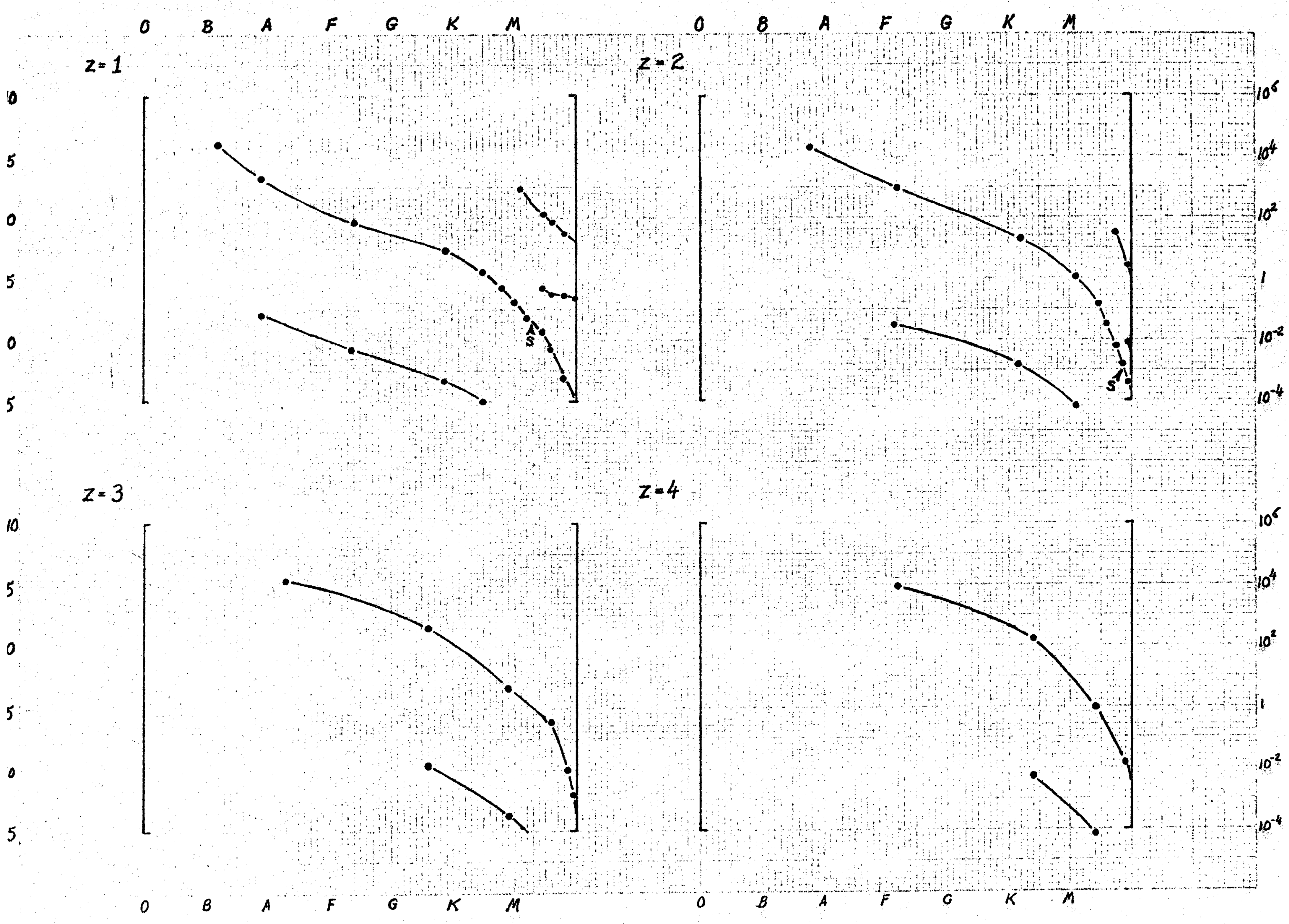
$$m' = m + 2.5 \log D - \frac{26{,}000\,K}{T} \cdot (1 - 1/D) \ .$$

Absolute magnitude is a logarithmic scale keyed to the star's luminosity (or power output), with a decrease of five magnitudes corresponding to an increase in luminosity by a factor of 100; the absolute magnitude of the Sun is about +5.

The above relations are applied to the H-R diagram for various extents of redshift. Cosmologists define a redshift value, z, which is related to the recession speed of a galaxy, $\beta = v/c$, by the equation:

$$z = \sqrt{\frac{1+\beta}{1-\beta}} - 1 \ .$$




Z=1
Z=2
Z=3
Z=4
0
B
A
F
G
K
M
S
10
5
0
5
0
5
10^6
10^4
10^2
1
10^{-2}
10^{-4}

For redshifts, the connection between the redshift level and the Doppler factor is $D = \frac{1}{z+1}$. The four smaller graphs show the H-R diagrams for the following values:

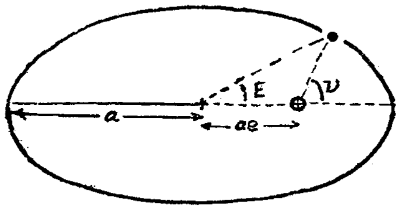
z	β	r (megaparsecs)
1	0.600	2400
2	0.800	3200
3	0.882	3530
4	0.923	3690

The distances listed for the receding galaxies are based on a value for the Hubble constant of 75 km/sec/megaparsec (a megaparsec is about 3.3 million light-years). From the graphs shown, it becomes evident why very distant galaxies are difficult to observe: just about all of the visible light is supplied by the very rare, hot, bright stars. The far more common, cooler stars have virtually all of their visible emissions shifted into the infrared.

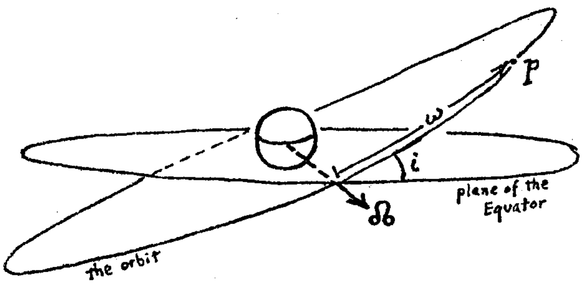
* * *

I will discuss here the geometry involved in determining the apparent path or "sky-track" of a geosynchronous satellite. At a later time, I will show how this can be applied to a couple of related problems.

First, we must look at the geometry of an orbit. Just six parameters are necessary to completely describe the position of a body in orbit. Two of these specify the size and shape of the orbit. (We will only deal with ellipses, since we are interested in closed trajectories here.) The semi-major axis, a, is just half of the long axis of the ellipse. The eccentricity, e, may be defined as the ratio of the distance from the center to one focus to the length of the semi-major axis. For an ellipse, the range is $0 \leq e < 1$. Three parameters suffice to specify the orientation of the orbit in space. The inclination, i, is the angle between the plane of the orbit and the plane of the Equator. The intersection of these two planes produces the line of nodes; the ascending node is the one through which an orbiting body is carried from below to above (or North) of the plane of the Equator. The direction of the ascending node, ☊, is measured eastward from the direction of the vernal equinox (but we shall not need that here). The argument of perigee, ω, is the angle measured along the orbit in the direction of orbital motion from the ascending node to the perigee of the orbit. The last parameter indicates the position of the body along its orbit. One value which may be used is T, the amount of time since the body last passed its perigee point. One may also use one of three angles: the mean anomaly, $M = \frac{T}{P} \cdot 2\pi$ radians, where P is the orbital period; the eccentric anomaly, E, measured from the center of the orbit, in the direction of motion, from perigee to the body; or the true anomaly, v, measured



plane view of an orbit; here Earth occupies one focus of the ellipse



three-dimensional view of an orbit; P marks the orbital perigee and ☊, the ascending node from the occupied focus of the orbit (in this case, the center of the Earth), in the direction of motion, from perigee to the body.

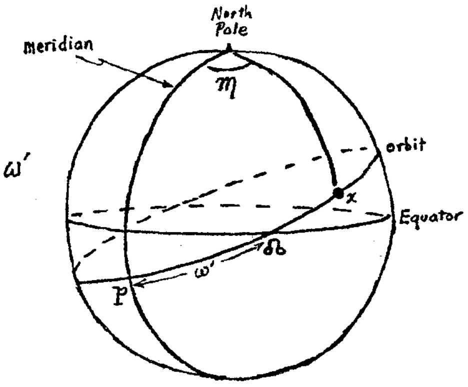
It can be seen that M advances in a perfectly uniform manner with the passing of time. However, an orbiting body does not move uniformly in its orbit: it travels fastest near perigee and slowest near apogee. This is seen in the following relations among the three anomalies:

$$M = E - e \sin E \quad , \quad \cos \nu = \frac{e - \cos E}{e \cos E - 1} \quad ,$$

where all angles are in radians (1 radian = $180/\pi$ degrees).

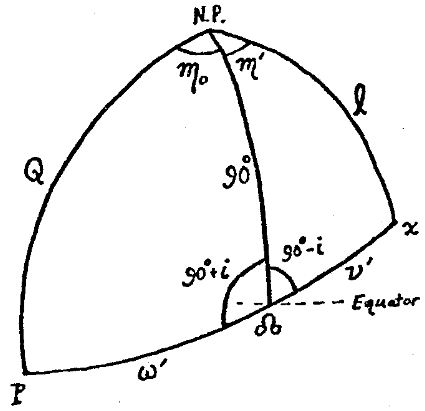
If the orbit is a circle, $e = 0$ and $M = E = \nu$; otherwise, $M = E = \nu$ only at perigee (where $M = 0$) or at apogee (where $M = \pi$ radians).

Let's make life easier for ourselves with a few simplifying assumptions. We will treat the satellite as exactly geosynchronous: we will take its orbital period as exactly one sidereal day ($23^h 56^m 4^s\!.091$), which fixes the orbital semi-major axis at $a = 6.61073\ R_\oplus$. One can imagine that if the orbit were a bit too large, the orbital period would be a little longer than a sidereal day, so the satellite would lag Earth's rotation and appear to a ground observer to drift west; similarly, if the orbit is a little too small, the satellite will appear to drift eastward. We will place our imaginary viewpoint at the center of the Earth, which is at one orbital focus, to simplify the consideration of line-of-sight; two graphs have been included, for one of the orbital situations, of an apparent satellite path seen from Earth's surface at the Equator and from 40° North latitude. The differences due to the shift in viewpoint are minor. Finally, we will assume that perigee lies on our meridian (north-south line); we can then reduce two parameters to one and define $\omega' \equiv 360° - \omega$ as the angle measured along the orbit in the direction of motion from perigee to the ascending node.



What remains to be determined is the angle, $\mathfrak{m}$, measured eastward at the North Pole from our meridian to the satellite's position. This may be obtained from the spherical triangles shown below, where we define $\nu' = \nu - \omega'$ and $\mathfrak{m} = \mathfrak{m}_0 + \mathfrak{m}'$. The relations derived are:

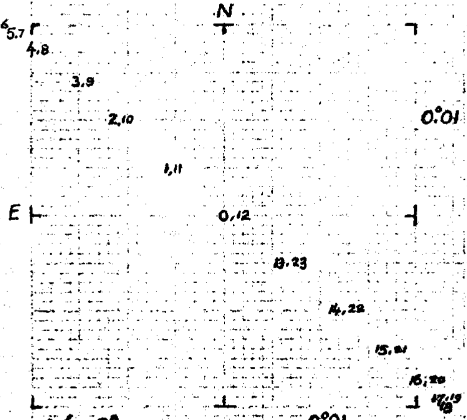
$$\cos Q = -\sin i \sin \omega' \ , \quad \cos \mathfrak{m}_0 = \cos \omega' / \sin Q \ ;$$
$$\cos \ell = \sin i \sin \nu' \ , \quad \cos \mathfrak{m}' = \cos \nu' / \sin \ell \ .$$



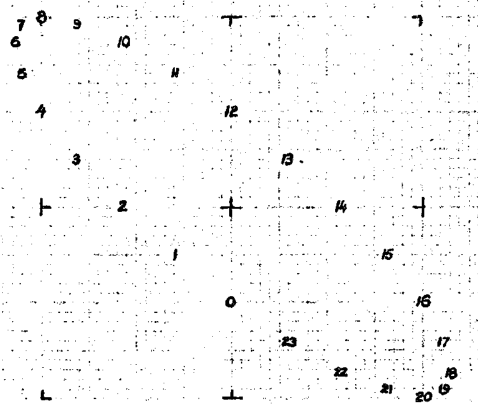
The angles $\mathfrak{m}$ and $(90° - \ell)$ give the position east or west of our meridian and north or south of the Equator, respectively.

The following pages of graphs illustrate apparent satellite paths for a variety of values of e, i, and ω' (typical values for Westar satellites are $e \sim 0.0002$ and $i \sim 0°\!.02$). The numbered points indicate T in sidereal hours. For low eccentricities, the paths are reminiscent of Lissajous figures, since the east-west and north-south angles behave nearly like sinusoidal functions. For an eccentricity of 0.2, however, the asymmetry between motion near perigee and near apogee becomes obvious.

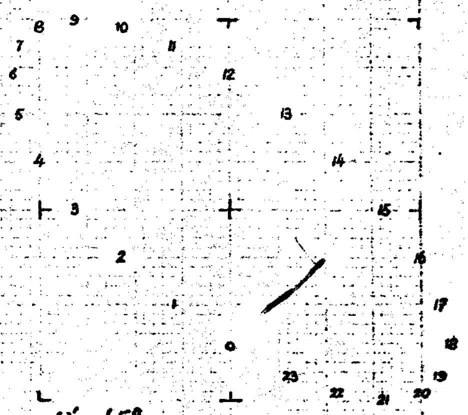
e = 0.0002 , i = 0°02 all graphs on this page are to the same scale



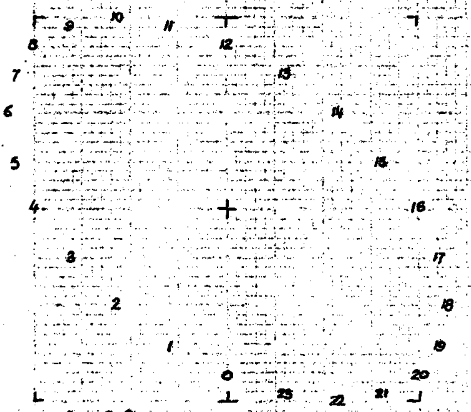
ω' = 0°



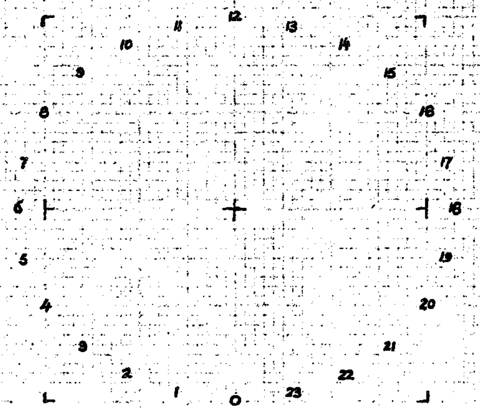
ω' = 30°



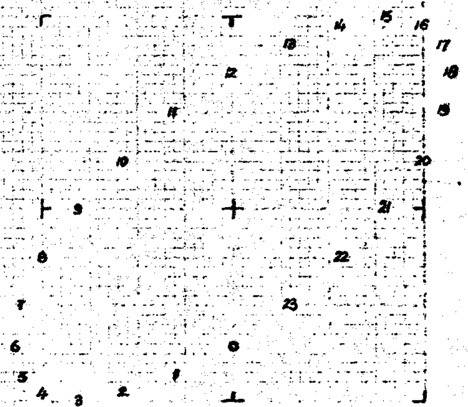
ω' = 45°



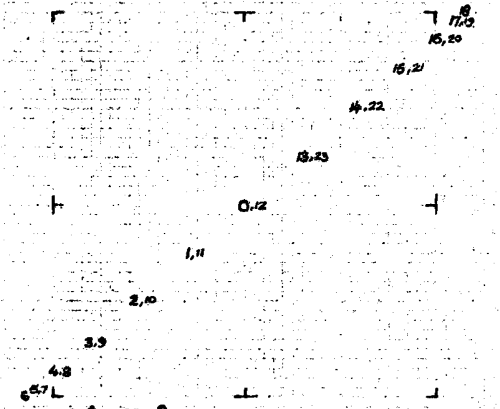
ω' = 60°



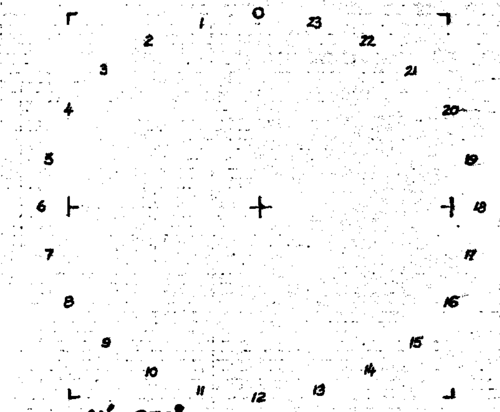
ω' = 90°



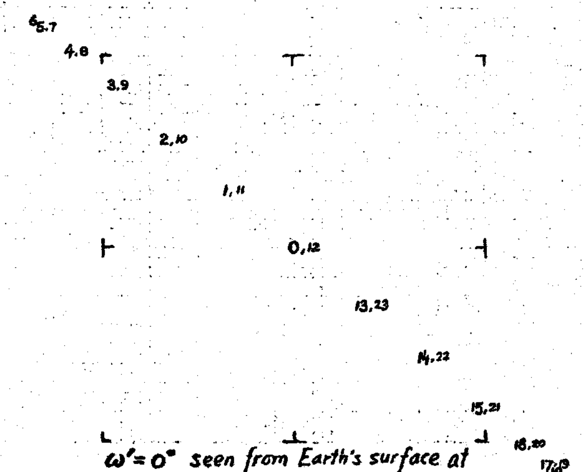
ω' = 135°



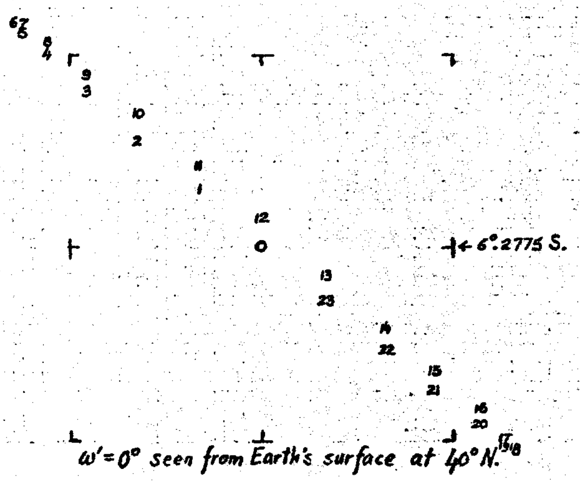
ω' = 180°



ω' = 270°



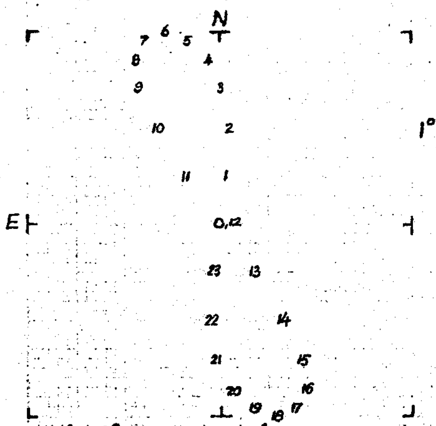
ω' = 0° seen from Earth's surface at the Equator



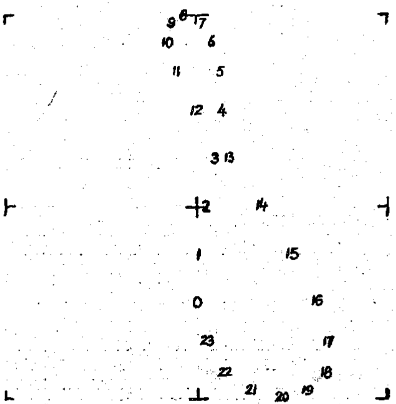
ω' = 0° seen from Earth's surface at 40° N.

$e = 0.0002,\ i = 2°$

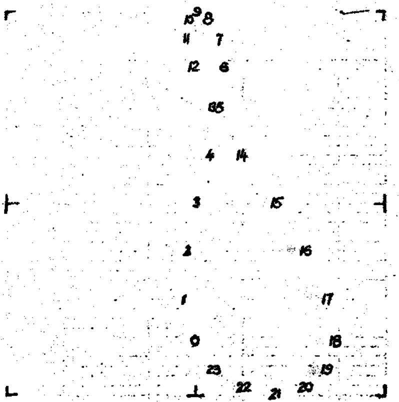
each set of five graphs is to the same scale



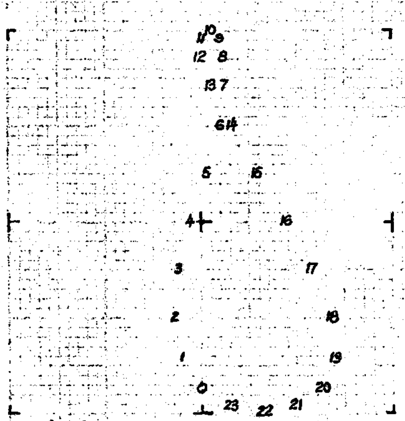
ω′ = 0° 0°.02



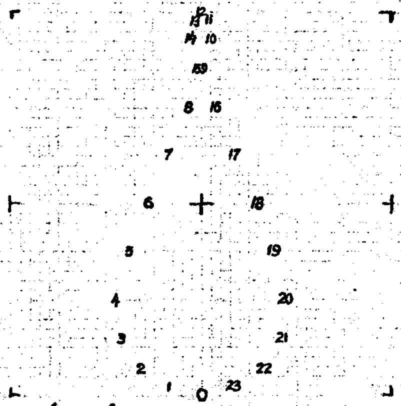
ω′ = 30°



ω′ = 45°

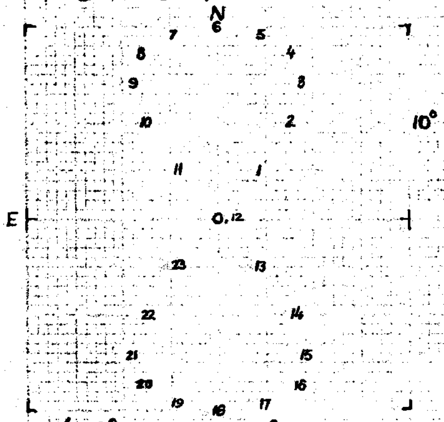


ω′ = 60°

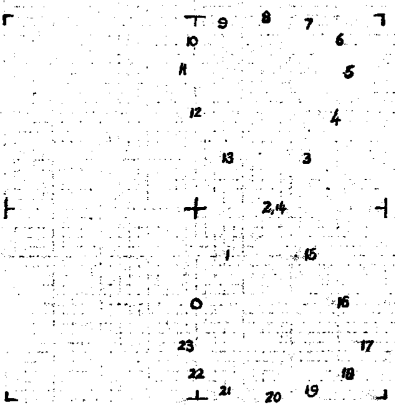


ω′ = 90°

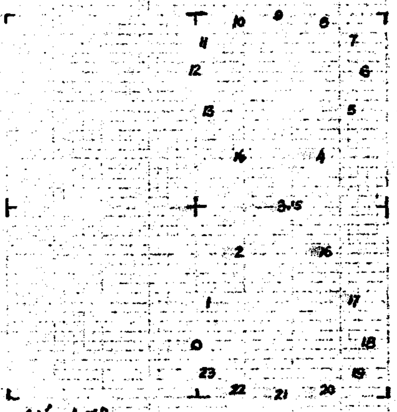
$e = 0.0002,\ i = 20°$



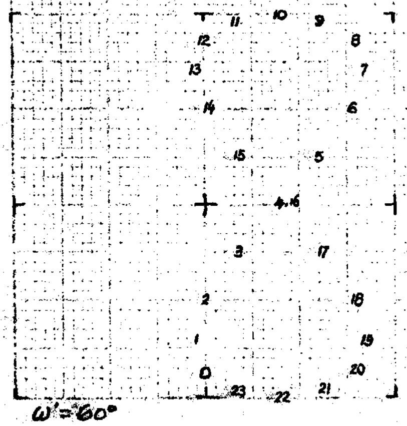
ω′ = 0° 1°



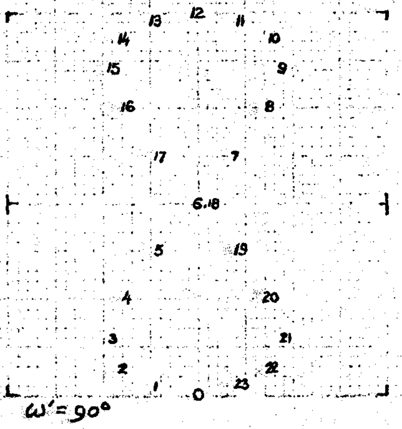
ω′ = 30°



ω′ = 45°



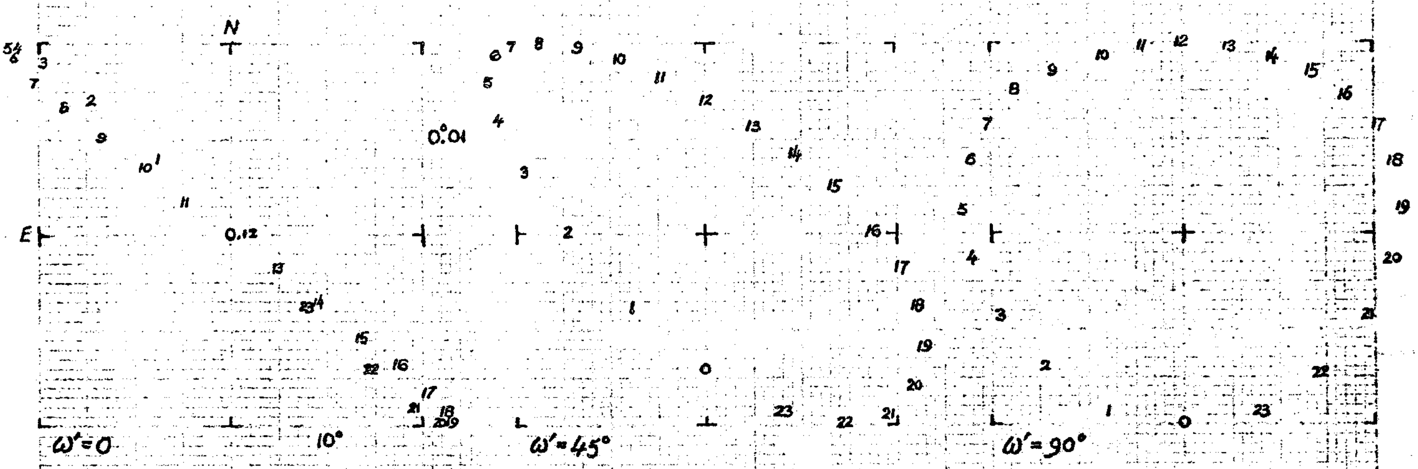
ω′ = 60°



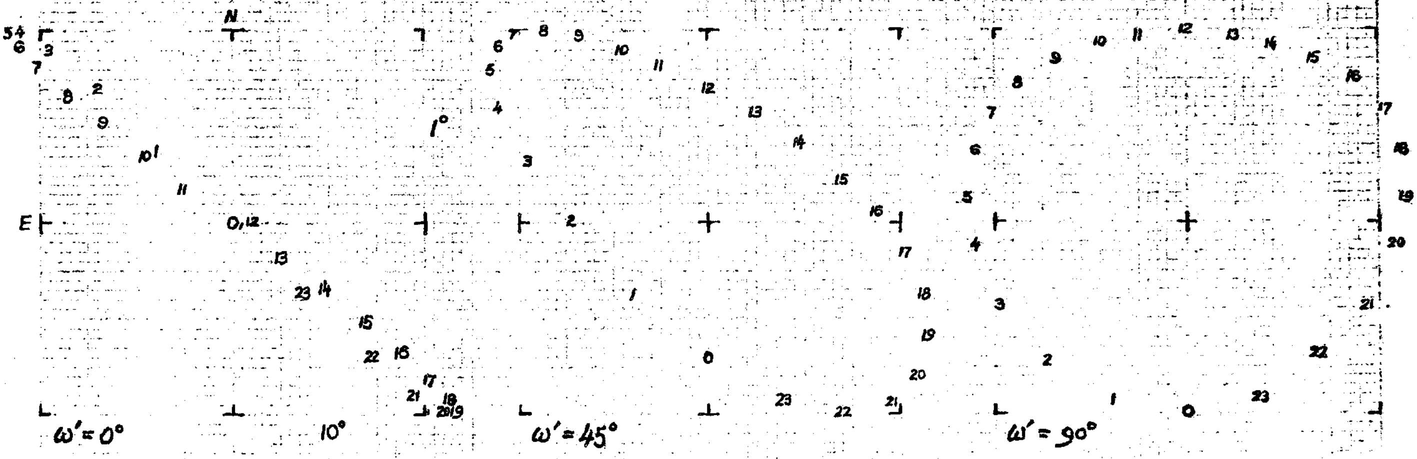
ω′ = 90°

each set of three graphs is to the same scale

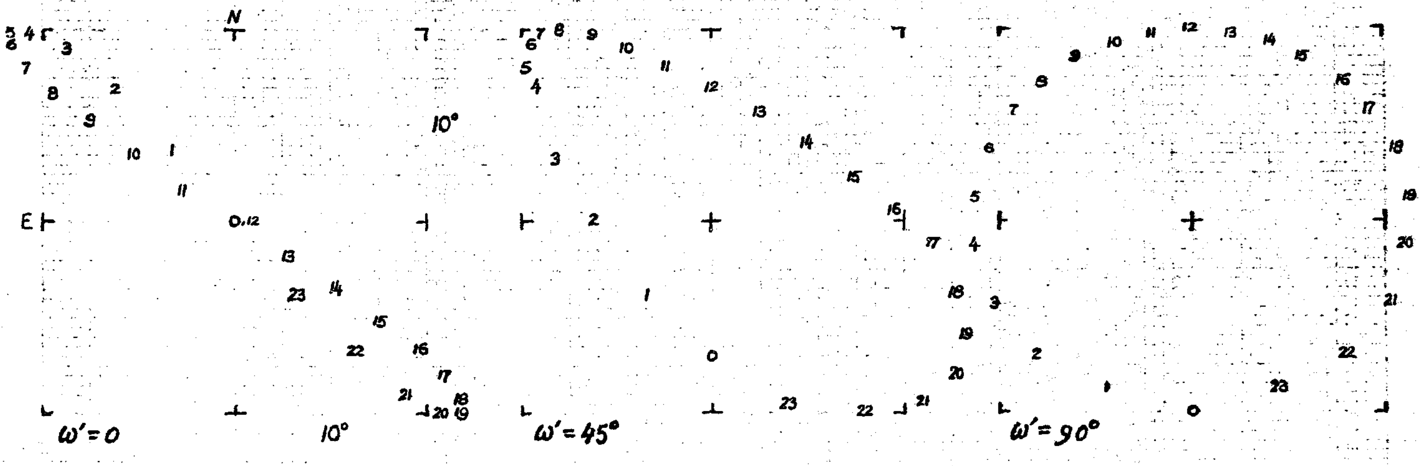
e = 0.2 , i = 0°.02



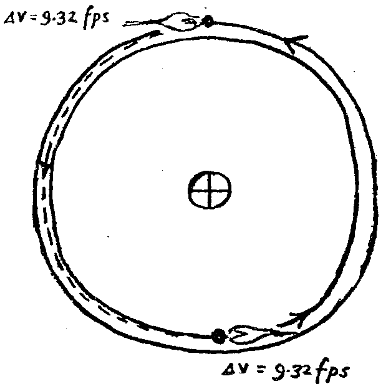
e = 0.2 , i = 2°



e = 0.2 , i = 20°



WU is contemplating the relocation of Westar I from its present location at 99° W. to 83° W. after the launch of Westar IV. They wish to complete this movement in about eight days. I was asked to sketch a description of the maneuver in order to determine how much fuel would be consumed.



transfer from synchronous to "drift" orbit

A geosynchronous satellite, as mentioned before, has an orbital period of 86,164 seconds, which requires an orbital semi-major axis of 6.61073 $R_\oplus$. If we wish to make the satellite drift 16° eastward in eight days, we must place it into a smaller orbit that will cover 362° per day. This new orbit would have a period of $\frac{360}{362}$ of a sidereal day, or 85,688 seconds, and a semi-major axis of 6.58636 $R_\oplus$.

One finds by examining the relative total energies of the two orbits that a velocity change of about 9.32 feet per second at the initial orbit and a change of very nearly the same amount in the same direction in the final orbit will produce the desired orbital transfer. The same changes must be made again in the reverse direction of motion to get the satellite back to the synchronous orbit. The entire group of four thruster firings consumes about three pounds of hydrazine, the amount we use in routine corrective maneuvers in about three months.

When the satellite is in transfer between the two orbits, it gains 0.°50 of longitude relative to the Earth's rotation. The complete maneuver schedule is as follows:

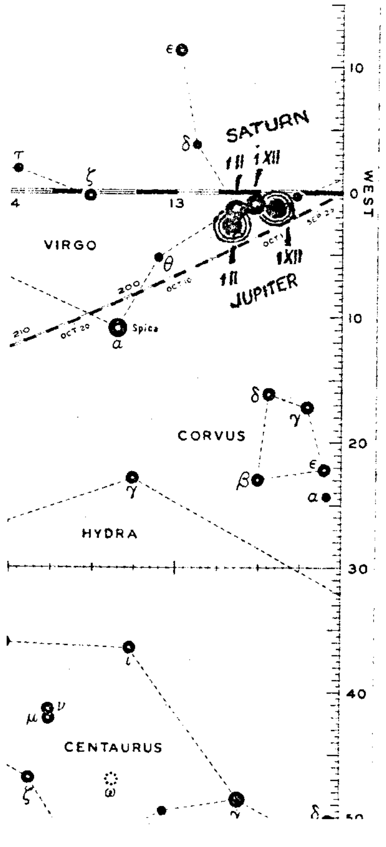
0.00 days : execute braking maneuver at 99.°0 W.
0.50 days : execute second braking maneuver at 98.°5 W.; satellite is now in "drift" orbit
8.00 days : execute acceleration maneuver at 83.°5 W.
8.50 days : execute second acceleration maneuver at 83.°0 W.; relocation in geosynchronous orbit is complete

The expected nominal longitudes of the five Westar satellites by January 1983 will be:

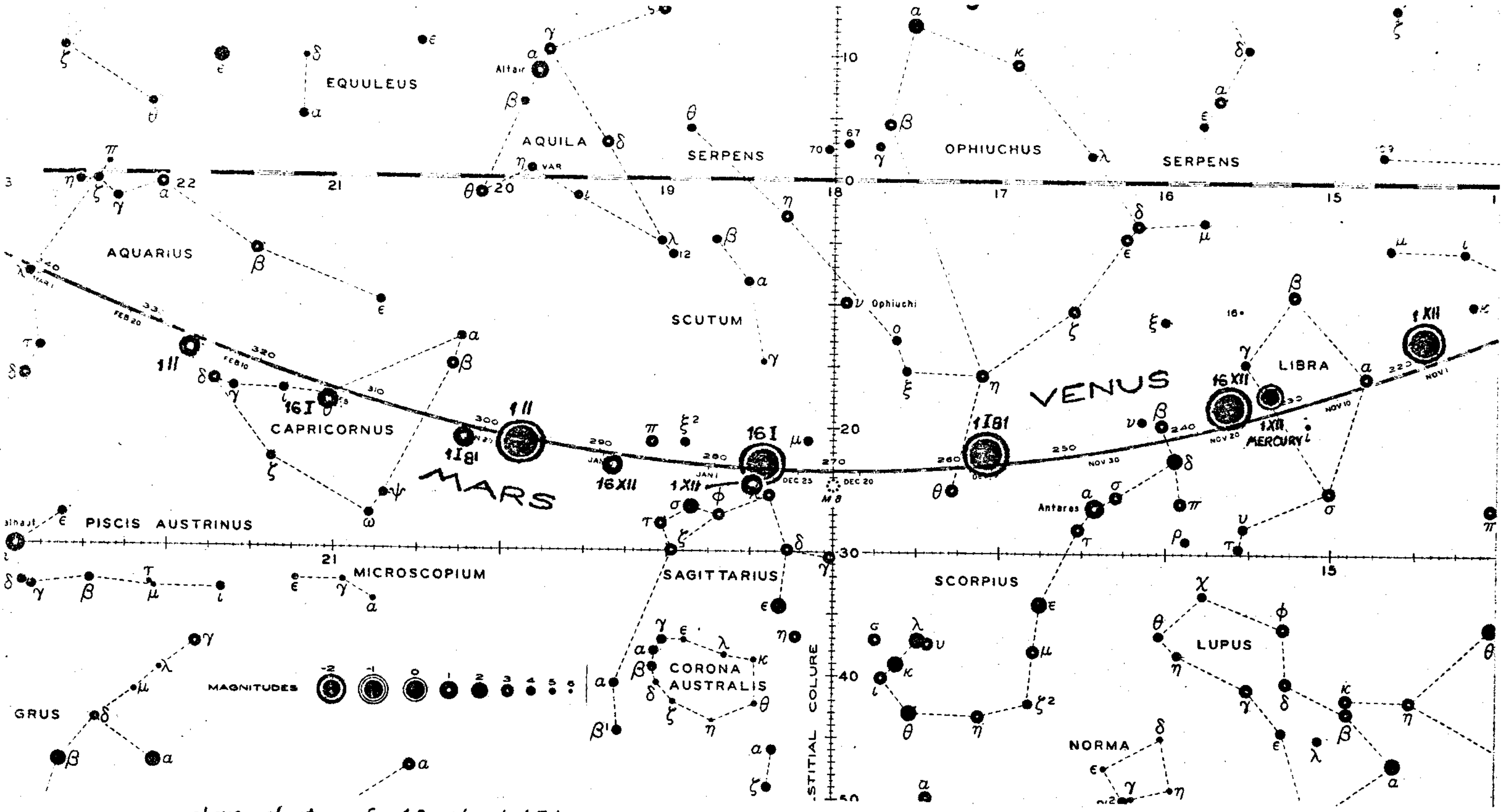
V	I	III	IV	II
(75° W.)	(83°)	(91°)	(99°)	(123.°5)

The apparent positions against the stars at 0^h Greenwich Sidereal Time (when the vernal equinox lies on the meridian at Greenwich) are shown in large- and small-scale sky charts for Glenwood (74.°494 W., 41.°212 N.) and Chicago (87.°7 W., 41.°9 N.); the local meridians at that moment are also indicated.

* * *

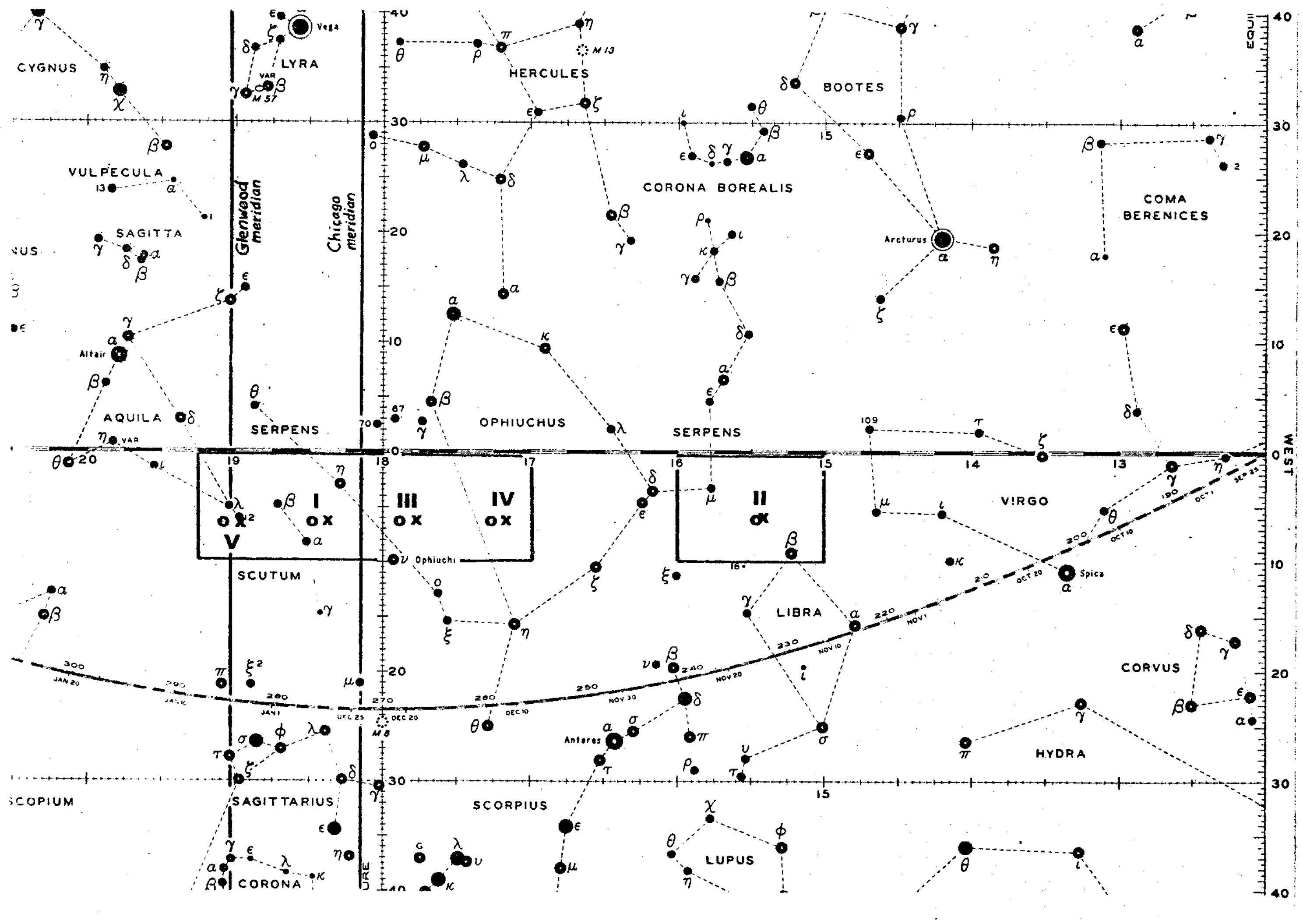


PLANET MAP: Venus is sinking rapidly toward the southeastern horizon with each successive dawn. Mars is still above the horizon at sunset, but is very low in the southwest. Mercury is also up near Mars, but is too close to the Sun to pick out; it will be higher above the horizon in early February. Jupiter and Saturn will be in conjunction at nearly the same spot in Virgo for the next few months. They presently rise before midnight; Jupiter is much the brighter of the two. Earth will be at perihelion at about 9 PM EST on January 2nd, at its minimal distance of 91.4 million miles (147.1 million km.)

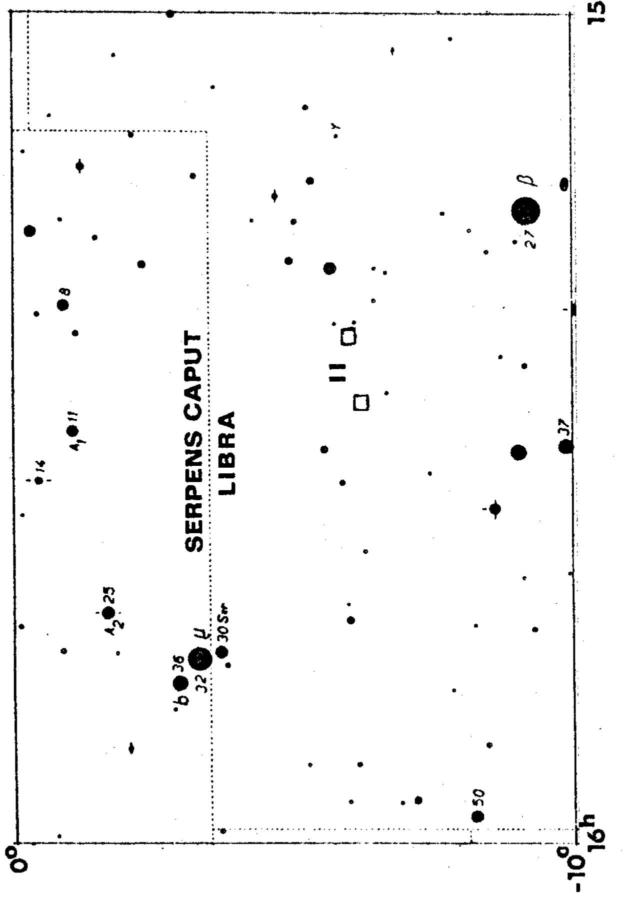


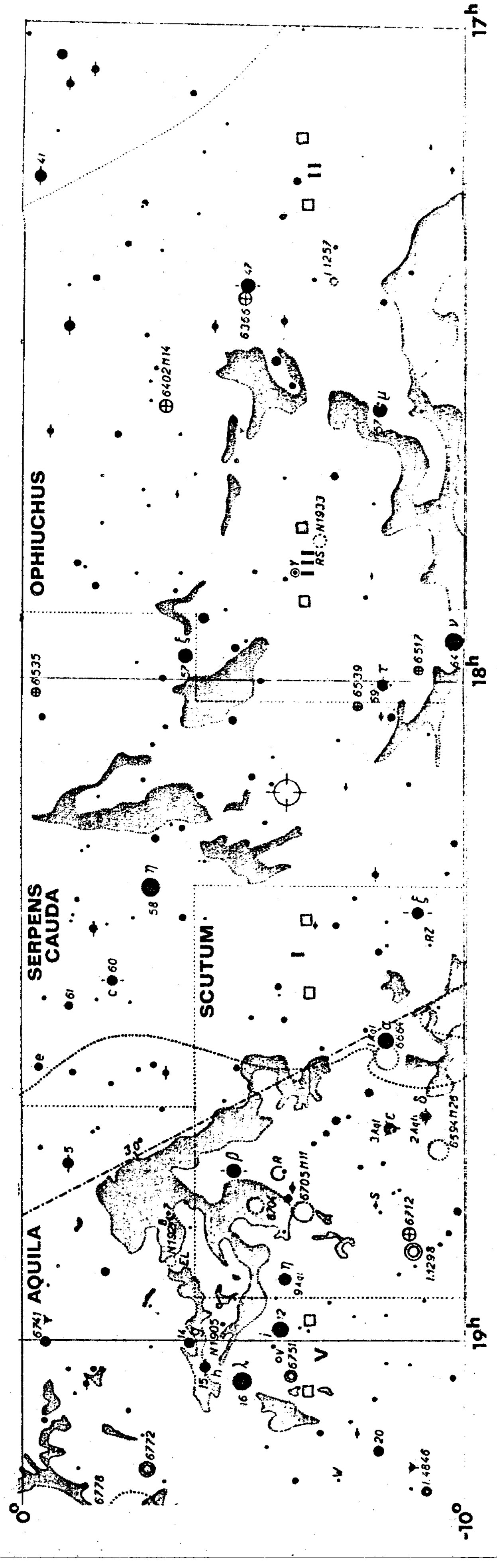
above: planet map for 1 December to 1 February

below: sky chart for Westar satellites at 0 hours Greenwich Sidereal Time, as seen from Glenwood (x) and Chicago (o)



enlargements of the outlined boxes in the large-scale sky chart; the apparent positions as seen from Glenwood and from Chicago are shown in their corresponding positions, surrounding by their 0.°1-maximum "drift" boxes





As an annual reminder, I will say that I write out comments only if I feel I have something to contribute. The phrase "RAEBNC" will be implicit throughout: I have read and enjoyed everybody's work, but I won't bother to say that I have nothing to say. There are also a few discussions raging from which I am refraining from tossing in my two-cents' worth, as I have to keep the bulk down somehow...

POLES OF ORDER 1 (AT #8) --

555: Okay, I'm crazy: put me down as an Emergency Editor. Just give me a month's warning, if you please. My address, after April, should be stable into 1982. I can gain access to Xerox equipment for the forseeable future.

CRAY: At least Ambercon got a better write-up than the *Boston Globe* gave Noreascon, which featured that SF great, Issac Asimov (sic). Might it be a good idea for conventions to prepare their own press releases so the facts aren't mangled and the tone does not condescend?

UNPAID BILL: Broke or not, you'll be kept under close scrutiny at art auctions...

Gee, my SCM250 has only been in the shop thrice in eleven years. It sounds like yours has a yellow, dimpled skin and is kind of tart.

I'm not going to complain about the length of your discussion of superconductivity (not in *this* issue, anyway). In fact, it was interesting to me and helped answer a few of the questions I asked last time (which you didn't see, since I didn't have a current address to mail *QS7* to you).

PIECE OF ANGRY CANDY: There was a strange article in the *Quarterly Journal of the Royal Astronomical Society* back in 1979 about how an advanced civilization might weather even the Heat Death (for those of you who plan to be around another 10^{14} years or so).

FORCED BUSSING: I believe the two English words in *Star Wars* are something like "SYSTEM INOPERATIVE" printed on the panel of the tractor beam control that Obi-Wan tampers with. I just regarded that as the same sort of simultaneous translation that is conducted with the spoken dialog.

I assumed that Luke's training session in *Empire* took place in "no-time", though I doubt that was the intention. Another thing that bothered me was how he got there: I didn't think fighter craft were capable of interstellar flight.

INSUFFICIENT SCOUNDRELS: Richard Thomas appeared on a New York talk-show to discuss *Battle Beyond the Stars*. He said that it was a movie that does not take itself seriously. They showed a love scene as the film clip: he sure was right, but the dialog seems so stilted to me that I couldn't work myself up to see it. Maybe I'll go if it shows up on a double feature at the Cort Theater for 99¢.

How much would you charge for a life-size plush bandersnatch? As a serious question, how much would you charge to make an 18" high Chmeee?

IN THE LAND OF SMOG AND HONEY: See, writing a 14-page 'zine isn't hard...

Your description of California driving makes it seem little different from driving I've contended with anywhere else in the country. I'd like to see drivers re-tested every couple years!

WESTECH: And what's *wrong* with reduced type? Don't you read *your* APA-TECH with a field ion microscope?

(Aside to GTB: does an Alice Insley cover on *The Mu-Betan* count as a page for her or for Mike?)

POLES OF ORDER 2 (AT #8) --

COHERENT WRITING: The last I heard on the nine-digit ZIP code is that the Senate is trying to sit on it: they're not convinced it'll save all that much money. They're not wild about a 30,000-page directory *or* a toll-free number, either...

A Northern Lights cigar would be an Aurora Corona Corona, but a solar wind cigar jammed into an SCM typewriter near Alphecca during a total eclipse would be a Corona Corona Corona Corona Corona Borealis. Enough, I'm getting a Coronary!

Don Martin reached me at the impressionable age of six and I've always enjoyed his particular brand of silliness. I'd like to get a pair of those hinged shoes his characters wear. PWING! GLUK-FWEEE!

We limited the number of Niven questions in the Whatcon Trivia Bowl, since we already had Rolf's fine Known Space Quiz, reprinted in this issue (and which I think you won, wise-guy).

PIECE OF ANGRY CANDY: When the Titans chose to assail Mount Olympus, they had to pile Mount Ossa upon Mount Pelion to make themselves a step-ladder (they came to a very sad end for their troubles). Hence, Ossa-on-Pelion's motto is "No Job Too Big!". Sometimes I fare better than the Titans did... There, now how about explaining some of *your* references in print, or are you going to insist on a S.A.S.E.?

I cannot claim credit for another man's work. "Close, But No Cigar" was the brainchild of John Nine. If we do the Chicon Trivia, that may be one of the *nicer* categories! (Well, maybe not, but we do try to go for the off-beat...)

(I did have a lot more comments for *AT* #8, but they were getting *really* stale.)

POLES OF ORDER 1 (AT #9) --

555: Fool that I am, I accept the position of Guest Editor for *AT* #13. I will announce my new address before the time comes...

I wasn't *blaming* you for not getting Marty's first contribution -- I just assumed you had all of the remaining copies. Anyway, I finally did receive my copy. I apologize for bothering you about it.

I have been sending my post-mailings to people who were listed on the previous two rosters, since they were theoretically the ones who would get the current APA, and directing the leftovers to you. Somehow I managed to miss a couple folks at the time...

TIME-DEPENDENT OPERATOR: You didn't really have to go and change your title...

The black-hole ad made me think of an astronomy final exam cover that I was given a copy of. Just the thing for the holidays... I will try to republish it somewhere around here (it's an Nth-generation Xerox). I thought that the Boston Museum of Science and a few other organizations had already auctioned off most of this Universe.

RENT-A-VIBE: Some of the toughest wargamers I know are pacifists, just as physicians make the worst patients. (Uh oh, is this an attack of the fifty-foot, radioactive glibs?) In my own case, I haven't decided whether I play out of intellectual amusement or to vent aggression. It appalls me to think that those little cardboard chips could actually represent living humans. I can't play "Nuclear War" more than once in a great while because the idea of wiping out several hundred million people in a single game gets to me. (I can play OGRE with a clear conscience: it involves cybernetic combatants.) Then again, why do some people like murder mysteries? Did you ever hear the story about the German generals in 1944 who fought out a simulation of the best way for the Allies to invade Europe, only a few hours before it was used successfully at Normandy?

YOUNG AND ABROAD AT THE (ONCE ONLY) RINGED PLANET: Some physicist was working on the idea that organic molecules in living things are preferentially levorotary due to the asymmetries of the weak nuclear interaction. If this is so, it would improve planetary compatibility a bit (including the compatibility of alien microbes with your body).

In his Extraterrestrial Civilizations, Asimov deals with the concept of the generation-ship as a means of interstellar travel. He suggests that it is more likely, in the long run, that such travellers would simply use the resources of a planetary system to replenish losses (and occasionally rebuild the ship) and head off again.

The Xerox Reproduction Center forgot to reduce one of my pages. It's times like this when I wonder whether photo-reduction is worth the trouble...

THE (adj.) MU-BETAN: Hope the galactic data I handed you was of assistance. Need more?

Only ten magazines? I'd have to drop about eight, though admittedly a few of them are 16-pagers or less. Most of them are connected with my most obvious field of interest...

I found your remarks about Chicago amusing. From across the Hudson, the skyline of New York seems to say to me, "G'wan, I dare you!"

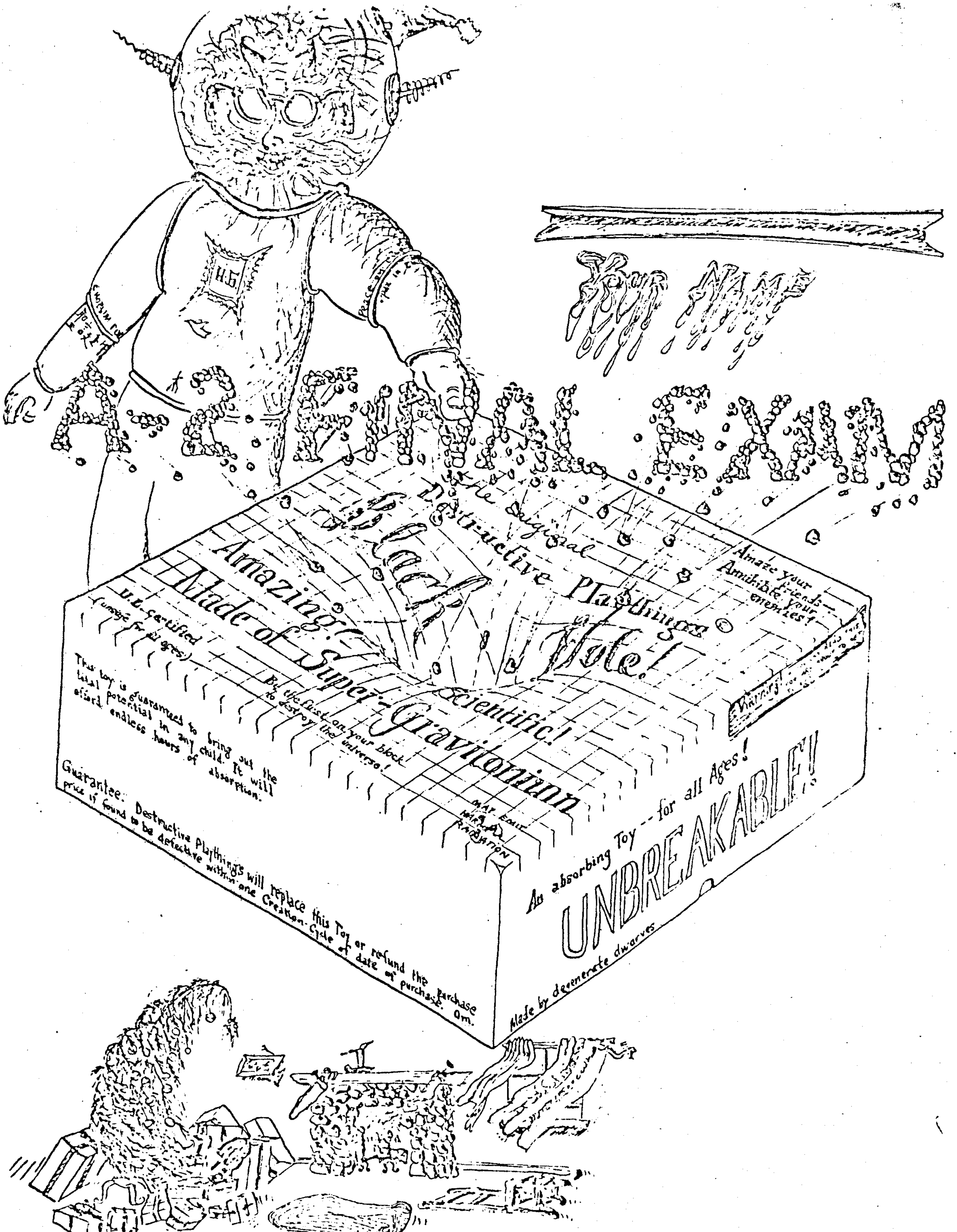
POLES OF ORDER 2 (AT #9) --

CONVEYOR OF CATEGORIES: Thank you for the additional laws; I was unaware they had names. I also like Krupla's Observation: If you see someone in a white lab coat, you can be sure s/he thinks s/he's a scientist. There's a little paperback out called something like 1001 Logical Laws; it seems to be a treasure trove of such items.

UNPLEASANT DIURNAL SHIVERS: Sure, you can go around using ellipses that way, if you're gonna punctuate properly...

Apparently, 1750 Arch Records has now released two volumes of Nancarrow's music as a two-record set. (Drat, what do you do if you already have Volume 1?)

Must be someone else who has the #4 transponder blown, someone like RCA. My partner Controller, whose former classmate works at the RCA station down the road, also tells me that Satcom Two is "falling apart". Tsk, tsk...


Your NAME
A FINAL EXAM
H.B.
The Original
Destructive Playthings ©
Black Hole!
Amazing!
Scientific!
Made of Super-Gravitonium
U.E. certified
(unsafe for all ages)
Be the first on your block to destroy the universe!
Amaze your friends—
Annihilate your enemies!
Warning!
This toy is guaranteed to bring out the total potential in any child. It will afford endless hours of absorption.
MAY EMIT HAWKING RADIATION
An absorbing Toy--for all Ages!
UNBREAKABLE!
Made by degenerate dwarves
Guarantee: Destructive Playthings will replace this Toy or refund the purchase price if found to be defective within one Creation-Cycle of date of purchase. Om.

THE TOOKIE MONSTER SEZ: A spinning galaxy was one of the errors; the other was that nice starry background in intergalactic space. (I can imagine how that happened: someone saw these photos of galaxies with all the stars around and reproduced it.)

No ballistic trajectory from the Earth's surface will get you into orbit. If you don't make escape speed (corrected for air resistance), you'll wind up back on the ground sooner or later. Your projectile needs to carry some propellant to alter its velocity vector, so that the trajectory "detaches" from the Earth.

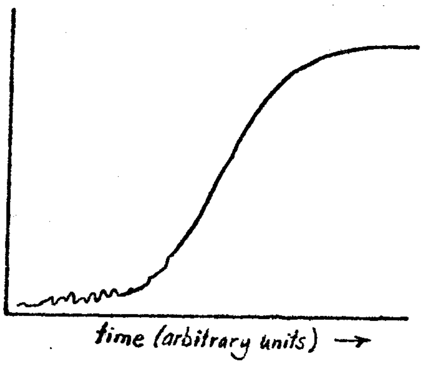
Have you looked into railguns? With the proposed muzzle velocities of 150 km/sec, if you aim toward Vega, you can throw things out of the Galaxy!

ALEXANDER GRAHAM BILL: Oh well, since I couldn't get a fix on your position, I foisted the problem onto GTB; I figured she'd get your new address when your next contribution arrived. All of this seems yet another good reason to get my submission in on time. All of this doesn't make it likelier that I will...

I agree with you in your discussion of the characters in Empire. What some people have been calling character development, I consider mere delineation, a filling-in of details. This alone doesn't make them any more real.

RENT-A-VIBE: I don't find any particular encroachment upon head-room in my Pacer. In fact, it has more space for my assorted anatomical components than every compact and many "full-size" cars that I've been in.

POWER OF PUTATIVE THINKING: You're right, of course (WHAT? He's RIGHT?!). Nature doesn't use simple linear differential equations because of problems such as explosive growth and endless oscillation. Thank goodness for damping! I've always liked the function which Phillip Morrison calls "the birth and growth of practically anything". After a shaky start, it undergoes exponential growth until other forces come into play, causing it to level off.



A DILLER, A DOLOR: The modern sky atlas has been tried a number of times, most often by radio and X-ray astronomers, for whom the classical constellations are pretty worthless. Constellations such as Ronald McDonald and the Batmobile have appeared. Even the National Lampoon turned Corvus into New Rock Album and the Gemini into Mork & Mindy. A modern mythological sky atlas should also relabel the few hundred bright named stars. With what we now know about some of these stars through contemporary astrophysics, numerous possibilities arise. Epsilon Lyrae, a quadruple star system, could be renamed Bob & Carol & Ted & Alice. The mind reels, or possibly gags. Are you sure this is less work than a Techie Tarot?

Frankly, I can't say that GT goes unnoticed by the outside world. I get the impression that other folks hear all the noise and either follow escape trajectories or, occasionally, stray through the event horizon.

I couldn't care less for Gribbin's apologia. It is just bad science to propound a flimsy theory, have the underpinnings yanked away, and then claim, "If my predictions hadn't been so extravagant, I'd have been in the clear." I think the line of investigation may be worthwhile and more data should be collected. I just can't help thinking that this guy likes having his name before the public...

(My criterion for basing a theory on available information is this: Imagine you are accused of a capital crime and must defend your plea of innocence on the basis of the evidence.)

* * *

In case you were wondering whatever happened to the author of KWIP and other unusual apazines, I reproduce below the text of a postcard I received (I don't think he'll mind):

11-18-80

Dear Greg,

Thanks for sending me your zine. Yes, I'd still be interested in getting it. Things are a little disorganized for me, since I just got married and moved to Georgia. I'm still working toward getting out of apas & into general publishing.

Surprisingly, cable-TV here is poorly run and has little of worth, so I'm learning to get most of my amusement from short-wave radio. Not that this paragraph is relevant, but it fit the space on the card. By the way, my new phone # is (912)-764-9851, just in case anyone asks. I'll be "in touch" later.

Kip Williams
312 S. Zetterower #5
Statesboro, GA 30458

I had a phone conversation with him a bit before that time. He indicated that he is withdrawing from APAs, so that he may devote more time to a single fanzine of his own. I have been sending him my stuff as barter. I'll let you know if I hear more...

* * *

POLES OF ORDER N --

SCIENCE VS. RELIGION

I'm a little disappointed that I failed to stir up any further discussion on this, after trying my best to bait you. I'm not sure just where I left off after all this time, so I will just speak my piece and hop down off the soap box.

What got me started on this was Jamie's protestations of the seriousness with which many people treat the Tarot, astrology, and other "occult" fields. As Gretchen has already said, most of these people only deal with these matters for amusement. I will not belabor the issue of whether there is anything to these disciplines. My own feeling is that they ought to be at least examined and not simply dismissed out of hand. (In my own case, I began my study of astrology for two reasons. One was the letter signed by N eminent astronomers and Nobel laureates, including my astronomy department head, proclaiming that astrology is bunk. That's as may be, but the declamation of a few dozen intellectual leaders is hardly going to put the public off something that's been around for at least five thousand years; in fact, it rather had a "banned in Boston" effect. I objected most to their use of "authority" to tell people what they should or should not accept. The other reason was that whenever I was introduced to most people as an astronomer, I was asked, "Oh, do you do horoscopes?"; I decided to learn how...)

The issue I am really concerned with is the suggestion that these mystical ideas have no place in "rational" thought and that "reasonable" people should have nothing to do with them. What I have been trying to show, in my oblique way, is that there is much less separation between science and religion (or mysticism) than is generally acknowledged. To deny any connection between the two is to neglect the examples set in the development of science and philosophy. It is certainly the case that science deals with mechanism and the physical realm, but the motivation to find those mechanisms and the approaches taken in finding them enter the realm of the ineffable.

In my own field, this sort of thinking is best represented in the persons of Aristotle, Copernicus, Kepler, and Einstein. I referred to Einstein as "one of the most successful mystics in human history: successful, because he formed a world-view which accurately describes the nature of the Universe as it is still understood. Were that view overthrown tomorrow, it would not diminish that accomplishment. I call him a mystic because of the kind of thinking he used to initiate his theories. His particular conception of the Creator and the kind of Universe such a Creator would produce led him to the necessary assumptions for his relativity theories. Einstein frequently spoke of the nature of God (He is subtle but not malicious, He does not roll dice, etc.) and these ideas did influence his thinking. Jacob Bronowski said of him, "He had a peculiar way of speaking sometimes as if God were his uncle and sometimes as if he were God's uncle." I haven't the space to elaborate on the work of these people and others, but I feel that an examination of their recorded thoughts shows that such a "mystical" connection is plainly there.

What then is the difference between science and mysticism? Science is of a self-correcting nature. It deals only with reproducible phenomena, since one must be able to isolate and examine carefully a mechanism or relationship in order to describe it accurately. It is an "economical" philosophy: Occam's "razor" directs a search first for simple hypotheses, which carries the implicit assumption that Nature is simple. It insists on a causal Universe: physical events occur due to acting mechanisms. It maintains that there is no "deceit" at work: Nature doesn't just happen to make things appear a certain way when they are "really" something quite different. It requires what is sometimes called the "cookability" of a theory: a theory is meaningless unless it leaves ways in which it may be attacked by rigorous tests; the more of these tests to which the theory is subjected and passes, the "stronger" it is. An untestable hypothesis can never be a scientific theory.

This is why a concept such as Creationism is not a "scientific" theory. It presumes that the physical evidence is not justification for an "evolutionary" model of the Universe because it is misinterpreted or deceives us into believing the World is much older than it is. I will grant that this could indeed be the case. Because of its very nature, science does not "prove" anything; it can only be a description of physical phenomena. On the other hand, hypotheses such as Creationism are untestable. No statement about the past is ultimately provable. The classic philosophical question is: Suppose the Universe and everything in it, including you and your memories of its past (and of various creation myths, if you like), were created just one second ago -- how could you know?

These issues (and others) must be decided by a combination of faith and logic. To my mind, which world-view one adopts is a matter of individual choice, but one must be aware of the hidden assumptions and the uncertainty of any knowledge. The Universe offers no indication of what beliefs are "right".

hop *clump* Thank you.

* * *

I tender my regrets that I cannot come to Ishercon; hope it is lots of fun. If the plane fares don't break me, I look forward to seeing you folks (as many as possible, anyway) frequently this winter.